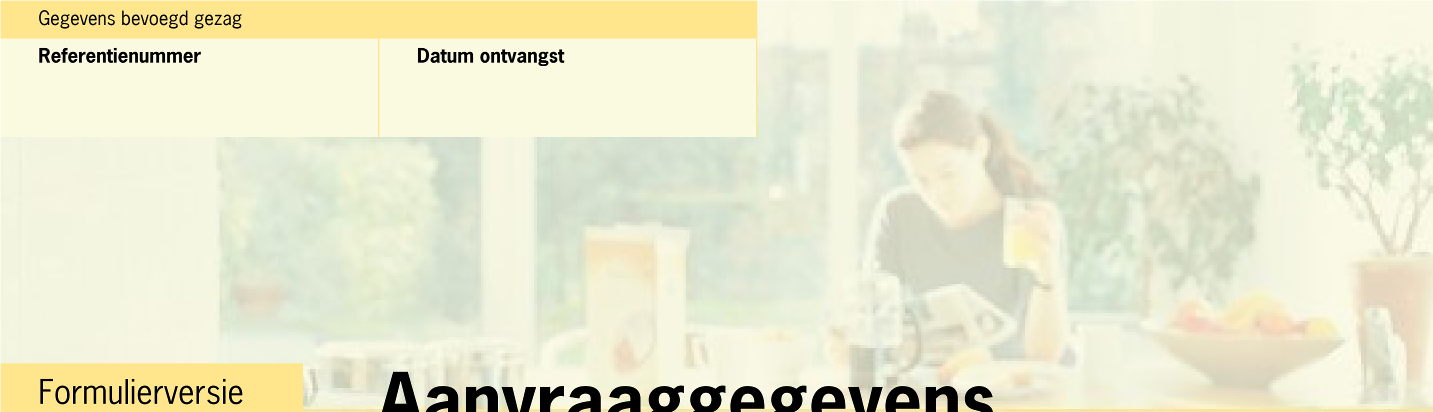
Gegevens bevoegd gezag

Referentienummer	Datum ontvangst



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Aanvraaggegevens

Ingediende aanvraag/melding

Aanvraagnummer	2601105
Aanvraagnaam	Net op zee Hollandse Kust (zuid)
Uw referentiecode	AH579-21
Ingediend op	28-02-2017
Soort procedure	Reguliere procedure
Projectomschrijving	Net op zee Hollandse Kust (zuid) zorgt ervoor dat de elektriciteit van de windturbines in de kavels van het windenergiegebied Hollandse Kust (zuid) naar het hoogspanningsnet op land (380 kV) kan worden getransporteerd. De scope van de vergunningaanvraag is opgenomen in paragraaf 1.5 van de toelichting behorende bij deze vergunningaanvraag.
Opmerking	-
Gefaseerd	Nee
Blokkerende onderdelen weglaten	Nee
Persoonsgegevens openbaar maken	Nee
Kosten openbaar maken	Nee
Bijlagen die later komen	-
Bijlagen n.v.t. of al bekend	-

Bevoegd gezag

Naam:	Ministerie I&M alleen voor defensie
Bezoekadres:	Inspectie Leefomgeving en Transport Graadt van Roggenweg 500 Utrecht
Postadres:	Postbus 16191 2500BD Den Haag
Telefoonnummer:	[redacted]
E-mailadres:	[redacted]
Website:	[redacted]
Contactpersoon:	[redacted]
Bereikbaar op:	Kantoortijden

Overzicht bijgevoegde modulebladen

Aanvraaggegevens

Aanvragergegevens

Locatie van de werkzaamheden

Werkzaamheden en onderdelen

Bouwwerk ten behoeve van het verkeer, de infrastructuur of openbare voorziening plaatsen

- Bouwen

Bijlagen

Kosten

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Aanvrager bedrijf

1 Bedrijf

KvK-nummer	09155985
Vestigingsnummer	000020300360
Statutaire naam	TenneT TSO BV
Handelsnaam	TenneT

2 Contactpersoon

Geslacht	☑ Man ☐ Vrouw
Voorletters	J.
Voorvoegsels	-
Achternaam	[redacted]
Functie	-

3 Vestigingsadres bedrijf

Postcode	6812AR
Huisnummer	310
Huisletter	-
Huisnummertoevoeging	-
Straatnaam	Utrechtseweg
Woonplaats	Arnhem

4 Correspondentieadres

Adres	Utrechtseweg 310 6812AR Arnhem

5 Contactgegevens

Telefoonnummer	0629360328
Faxnummer	-
E-mailadres	[redacted]

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Gemachtigde bedrijf

1 Bedrijf

KvK-nummer	38020751
Vestigingsnummer	000007345658
Statutaire naam	Witteveen+Bos
Handelsnaam	Witteveen+Bos

2 Contactpersoon

Geslacht	☐ Man ☑ Vrouw
Voorletters	[redacted]
Voorvoegsels	-
Achternaam	[redacted]
Functie	adviseur vergunningen

3 Vestigingsadres bedrijf

Postcode	7411 SC
Huisnummer	2
Huisletter	-
Huisnummertoevoeging	-
Straatnaam	van Twickelostraat
Woonplaats	Deventer

4 Correspondentieadres

Postbus	233
Postcode	7400 AE
Plaats	Deventer

5 Contactgegevens

Telefoonnummer	[redacted]
Faxnummer	-
E-mailadres	[redacted]

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Locatie

1 Locatieaanduiding

Locatie waar de werkzaamheden plaatsvinden

- [ ] Adres
- [ ] Kadastraal perceelnummer
- [x] Locatie op Noordzee, Waddenzee of IJsselmeer

2 Aanvulling locatieaanduiding

Coördinatenstelsel

- [ ] RD
- [x] ETRS89 / WGS84

Invoerwijze

- [x] Graden.decimale graden
- [ ] Graden.minuten.decimale minuten
- [ ] Graden.minuten.seconden.decimale seconden

Lengte	004,084648°
Breedte	52,257732°

3 Toelichting

Eventuele toelichting op locatie

De coördinaten zijn in ETRS 1989 UTM zone 31 N:
ET_X = 574032.2
ET_Y = 5790258.7

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Bouwen

Bouwwerk ten behoeve van het verkeer, de infrastructuur of openbare voorziening plaatsen

1 De bouwwerkzaamheden

Wat is er op het bouwwerk van toepassing?	☐ Het wordt geheel vervangen ☐ Het wordt gedeeltelijk vervangen ☑ Het wordt nieuw geplaatst
Eventuele toelichting	Realisatie van platform Beta binnen de 12-mijlszone
Hebt u voor deze bouwwerkzaamheden al eerder een vergunning aangevraagd?	☐ Ja ☑ Nee

2 Plaats van het bouwwerk

Waar gaat u bouwen?	Terrein

3 Bruto vloeroppervlakte bouwwerk

Verandert de bruto vloeroppervlakte van het bouwwerk door de bouwwerkzaamheden?	☑ Ja ☐ Nee
Wat is de bruto vloeroppervlakte van het bouwwerk in m2 voor uitvoering van de bouwwerkzaamheden?	0
Wat is de bruto vloeroppervlakte van het bouwwerk in m2 na uitvoering van de bouwwerkzaamheden?	7500

4 Bruto inhoud bouwwerk

Verandert de bruto inhoud van het bouwwerk door de bouwwerkzaamheden?	☑ Ja ☐ Nee
Wat is de bruto inhoud van het bouwwerk in m3 voor uitvoering van de bouwwerkzaamheden?	0
Wat is de bruto inhoud van het bouwwerk in m3 na uitvoering van de bouwwerkzaamheden?	90000

5 Oppervlakte bebouwd terrein

Verandert de bebouwde oppervlakte van het terrein na uitvoering van de bouwwerkzaamheden?	☑ Ja ☐ Nee

Wat is de bebouwde oppervlakte van het terrein in m2 voor uitvoering van de bouwwerkzaamheden? 0

Wat is de bebouwde oppervlakte van het terrein in m2 na uitvoering van de bouwwerkzaamheden? 1500

6 Seizoensgebonden en tijdelijke bouwwerken

Gaat het om een seizoensgebonden bouwwerk?
- [ ] Ja
- [x] Nee

Gaat het om een tijdelijk bouwwerk?
- [x] Ja
- [ ] Nee

Hoeveel hele jaren blijft het bouwwerk op de locatie bestaan? 35

Hoeveel maanden? 0

7 Gebruik

Waar gebruikt u het bouwwerk en/of terrein momenteel voor?
- [ ] Wonen
- [x] Overige gebruiksfuncties

Geef aan waar u het bouwwerk en/of terrein momenteel voor gebruikt. Noordzee

Waar gaat u het bouwwerk voor gebruiken?
- [ ] Wonen
- [x] Overige gebruiksfuncties

Geef aan waar u het bouwwerk voor gaat gebruiken. Het platform wordt gerealiseerd voor de aansluiting van de windturbines in windgebied Hollandse Kust (zuid). Elektriciteit wordt omgezet van 66 kV naar 220 kV.

8 Gebruiksfuncties

In onderstaande tabel staan in de eerste kolom mogelijke gebruiksfuncties die in een bouwwerk kunnen voorkomen. Vul voor alle gebruiksfuncties die voor u van toepassing zijn het aantal personen, de totale gebruiksoppervlakte en de totale vloeroppervlakte van het verblijfsgebied in m2 in hele getallen in.

Gebruiksfunctie	Aantal personen	Gebruiksoppervlakte (m2)	Verblijfsoppervlakte (m2)
Bijeenkomst			
Cel			
Gezondheidszorg			
Industrie			
Kantoor			
Logies			
Onderwijs			
Sport			
Winkel			
Overige gebruiksfuncties			

9 Uiterlijk bouwwerk/welstand

Beschrijf van de onderstaande onderdelen de materialen en kleuren die u voor het bouwwerk gebruikt. U mag het veld leeg laten als u materialen en kleuren in de bijlagen vermeldt

Onderdelen	Materiaal	Kleur
Gevels		
- Plint gebouw		
- Gevelbekleding		
- Borstweringen		
- Voegwerk		
Kozijnen		
- Ramen		
- Deuren		
- Luiken		
Dakgoten en boeidelen		
Dakbedekking		

Vul hier overige onderdelen en bijbehorende materialen en kleuren in.

Zie Toelichting aanvraag omgevingsvergunning bouwen offshore platform Beta

10 Mondeling toelichten

Ik wil mijn bouwplan mondeling toelichten voor de welstandscommissie/ stadsbouwmeester.

- [ ] Ja
- [x] Nee

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Bijlagen

Formele bijlagen

Naam bijlage	Bestandsnaam	Type	Datum ingediend	Status document
Toelichting aanvraag Beta	376_17-002-705--rapd--Toelichting aanvraag omgevingsvergunning Beta zonder bijlagen.pdf	Bestemmingsplan, beheersverordening en bouwverordening complexere bouwwerken Overige gegevens veiligheid Constructieve veiligheid complexere bouwwerken Welstand Gelijkwaardigheid Gegevens en bescheiden over veiligheid en het voorkomen van hinder t.b.v. bouwwerkzaamheden Plattegronden, doorsneden en detailtekeningen bouwen Kwaliteitsverklaringen Anders	2017-02-28	In behandeling
Bijlage I tekeningen_pdf	Bijlage I Situatie- en constructietekeningen.pdf	Plattegronden, doorsneden en detailtekeningen bouwen Anders	2017-02-28	In behandeling
Bijlage II Method Statement	Bijlage II Method Statement HKZ installation.pdf	Anders	2017-02-28	In behandeling
Bijlage III Basic Design rapport_pdf	Bijlage III Basic Design rapport.pdf	Anders	2017-02-28	In behandeling
Bijlage IV Certificering_-pdf	Bijlage IV Certificering.pdf	Anders	2017-02-28	In behandeling
Bijlage V Plattegrond brandbeveiliging	Bijlage V Plattegrond brandbeveiliging platform Beta.pdf	Anders	2017-02-28	In behandeling
Bijlage VI Melding activiteitenbesluit	Bijlage VI Melding activiteitenbesluit-.pdf	Anders	2017-02-28	In behandeling
Bijlage VII Gelijkwaardigheideisen	Bijlage VII Gelijkwaardigheideisen Bouwbesluit en DNVGL-ST-0145 standaard voor Offshore substations.pdf	Gelijkwaardigheid Anders	2017-02-28	In behandeling
Machtiging incl uittreksel KvK_pdf	Machtiging incl uittreksel KvK.pdf	Anders	2017-02-28	In behandeling

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2017.01

Kosten

Projectkosten

Wat zijn de geschatte kosten voor het totale project in euro's (exclusief BTW)?

Net op zee Hollandse Kust (zuid)

Toelichting aanvraag omgevingsvergunning bouwen voor platform Beta

TenneT TSO B.V.

28 februari 2017

Project	Net op zee Hollandse Kust (zuid)
Document	Toelichting aanvraag omgevingsvergunning bouwen voor platform Beta
Status	Definitief
Datum	28 februari 2017
Referentie	AH579-21/17-002.705

Opdrachtgever	TenneT TSO B.V.
Projectcode	AH579-21
Projectleider	
Projectdirecteur	

Auteur(s)	
Gecontroleerd door	
Goedgekeurd door	
Paraaf	

Adres

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+31 (0)76 523 33 33
www.witteveenbos.com
KvK 38020751

INHOUDSOPGAVE

	Bijlage(n)	Aantal pagina's
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V	Plattegrond brandbeveiliging platform Beta	7
VI	Melding activiteitenbesluit	2
VII	Gelijkwaardigheideisen Bouwbesluit en DNVGL-ST-0145 standaard voor Offshore substations	12

1

INLEIDING

1.1 Aanleiding, nut en noodzaak

Nederland heeft doelstellingen geformuleerd en in Europees verband afspraken gemaakt over het realiseren van de opwekking van duurzame - hernieuwbare - energie. Windenergie speelt daarin een prominente rol. Naast windenergie op land zijn doelstellingen geformuleerd voor windenergie op zee. Deze doelstellingen zijn herzien en concreet gemaakt in het Energieakkoord voor duurzame groei [lit. 1]. Daarin is afgesproken dat 4.450 MW aan windvermogen op zee operationeel is in 2023. Op dit moment is circa 1.000 MW gerealiseerd. Dit betekent dat er nog 3.450 MW moet worden gerealiseerd.

In de Routekaart voor windenergie op zee [lit. 2] is besloten om de doelstelling van 3.500 MW te faciliteren in drie gebieden, te weten Borssele, Hollandse Kust (zuid) en Hollandse Kust (noord). Daarbij is besloten dat het windenergiegebied Hollandse Kust (zuid) (hierna: HKZ) als tweede kan worden ontwikkeld, na windenergiegebied Borssele. Het windenergiegebied Hollandse Kust (zuid) biedt ruimte aan 1.400 MW windvermogen. De Routekaart geeft aan dat de uitgifte van de kavels van Hollandse Kust (zuid) in 2017 en 2018 plaatsvindt.

Het Rijk heeft besloten om de uitrol van deze 3.500 MW te faciliteren met een nieuw uitgiftesysteem voor windparken op zee. Dit besluit is vastgelegd in de Wet windenergie op zee (in werking getreden op 1 juli 2015) [lit. 3]. De Wet windenergie op zee biedt het Rijk de mogelijkheid kavels uit te geven voor de ontwikkeling van windparken op zee. In de wijziging van de Elektriciteitswet 1998 [lit. 4] is daarnaast TenneT aangewezen als netbeheerder op zee. In deze rol is TenneT verantwoordelijk voor voorbereiding, aanleg en beheer van de netaansluiting van offshore windparken. Zo ook voor het net op zee HKZ.

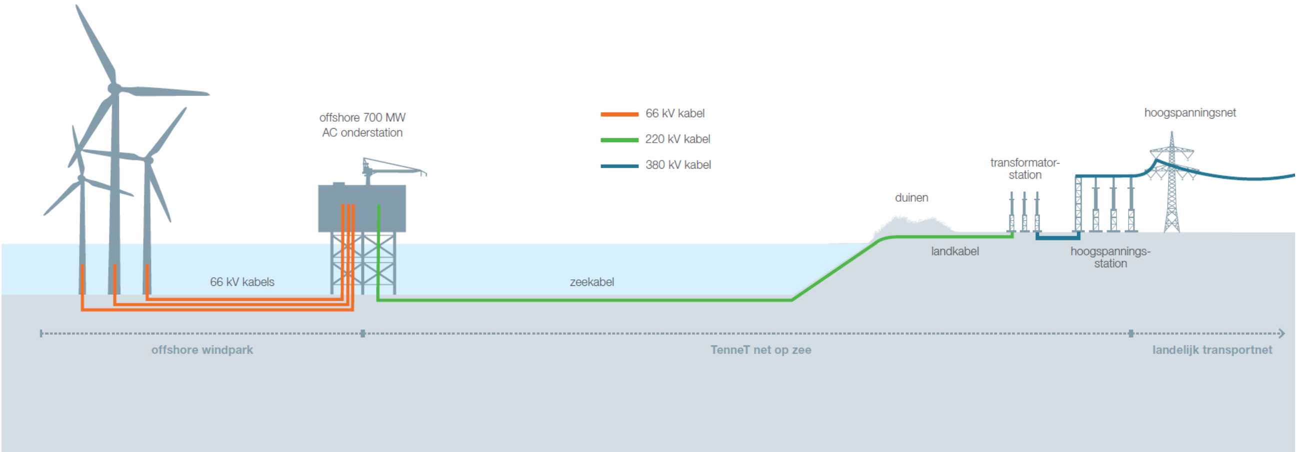
Het nieuwe uitgiftesysteem is op vele fronten beter dan het realiseren van individuele aansluitingen. Immers door de investeringen in infrastructuur op zee bij TenneT te bundelen, ontstaan synergievoordelen, zoals voordelige financiering, inkoopvoordeel, standaardisatievoordeel en voordeel door kennisontwikkeling. TenneT werkt daarbij samen met alle relevante partijen. Een gecoördineerde aansluiting van windparken op zee leidt daardoor tot lagere maatschappelijke kosten en minder impact op de leefomgeving.

Net op zee HKZ zorgt ervoor dat de elektriciteit van de windturbines in de kavels van het windenergiegebied Hollandse Kust (zuid) naar het hoogspanningsnet op land (380 kV) kan worden getransporteerd. Met net op zee HKZ levert TenneT een bijdrage aan de energietransitie in Nederland door een toekomstbestendig net op zee te realiseren, dat aansluit bij de Routekaart windenergie op zee [lit. 2].

1.2 Net op zee Hollandse Kust (zuid)

TenneT is initiatiefnemer van het project net op zee HKZ. Windenergiegebied HKZ biedt ruimte aan 1.400 MW. In de Routekaart voor windenergie op zee is aangegeven, dat voor de aansluiting van dit vermogen op het hoogspanningsnet gebruik wordt gemaakt van standaard platforms, waarop per platform 700 MW windenergiecapaciteit kan worden aangesloten. Dit betekent dat TenneT als onderdeel van het net op zee HKZ twee platforms wil realiseren (1.400 MW), die elk met twee 220 kV-kabels aansluiten op het landelijke hoogspanningsnet. De windturbines in de aangewezen gebieden worden direct aangesloten op de twee te realiseren platforms, zodat verzamelplatforms bij de windparken zelf overbodig zijn. Dit leidt tot kostenreductie. Om een tijdige realisatie van de windparken te kunnen faciliteren, moet platform Alpha uiterlijk 2021 in bedrijf zijn en platform Beta in 2022. In afbeelding 1.1 zijn de onderdelen net op zee HKZ schematisch weergegeven.

Afbeelding 1.1 Onderdelen project net op zee HKZ



Het project net op zee HKZ bestaat uit de volgende vier hoofdonderdelen:

1 twee platforms op zee voor de aansluiting van de windturbines, inclusief een back-up kabel[1] tussen beide platforms in geval van storing op of beschadiging van één van de kabels);
2 vier kabelsystemen op zee (vanaf elk platform komen twee kabelsystemen aan land);
3 vier kabelsystemen op land tot aan het transformatorstation, hierna twee kabelsystemen op land voor de aansluiting van het transformatorstation op het bestaande 380 kV-hoogspanningsstation;
4 realisatie van een transformatorstation op land met transformatoren die de stroom van 220 kV naar 380 kV transformeren, welke aansluit op het bestaande 380 kV-hoogspanningsstation.

Afbeelding 1.2 geeft de locatie weer van het windenergiegebied Hollandse Kust (zuid) met de platforms van TenneT en de locatie van het bestaande 380 kV-hoogspanningsstation.

[1] Een back-up kabel is een extra kabel met als doel de beschikbaarheid van het net op zee te verhogen. Als er bijvoorbeeld één kabel wordt beschadigd, kan transport via de tweede kabel blijven doorgaan.

Afbeelding 1.2 Windenergiegebied Hollandse Kust (zuid), inclusief platforms en bestaande 380 kV-hoogspanningsstation

1.3 Rijkscoördinatieregeling

De minister van Economische Zaken (EZ) heeft op grond van artikel 3.35, eerste lid, van de Wet ruimtelijke ordening (Wro), door middel van een separaat besluit (DGETM-ED/15159844 d.d. 13 november 2015) - om redenen van verwezenlijking van onderdelen van het nationaal ruimtelijk beleid - de rijkscoördinatieregeling van toepassing verklaard op de voorbereiding van het project net op zee Hollandse Kust (zuid). De Minister van Economische Zaken (EZ) is daarvoor de projectminister en het coördinerend bevoegd gezag.

Het bevoegd gezag voor het nemen van het uitvoeringsbesluit, waarmee de hier gevraagde omgevingsvergunning verleend kan worden, is het ministerie van Economische Zaken. Onderstaande uitvoeringsbesluiten worden gecoördineerd voorbereid met het inpassingsplan en deze omgevingsvergunning bouwen (Beta):

- vergunning op basis van de Wet natuurbescherming;
- omgevingsvergunning bouwen en milieu (onshore transformatorstation);
- watervergunning;
- spoorwegvergunning.

1.4 Wettelijk kader

Omgevingsvergunning bouwen

De omgevingsvergunning bouwen wordt aangevraagd in het kader van de Wet algemene bepalingen omgevingsrecht (Wabo). Platform Beta bevindt zich binnen de 12-mijlszone en is groter dan 15 m^2, waardoor een omgevingsvergunning bouwen noodzakelijk is voor het platform Beta (Artikel 2, lid 18, sub a van bijlage II bij het Besluit omgevingsrecht (Bor)).

Buiten de 12-mijlszone geldt geen omgevingsvergunningplicht voor platform Alpha (Artikel 2, lid 18, sub a van bijlage II bij het Besluit omgevingsrecht (Bor)).

Melding activiteitenbesluit

In categorie 20.1b, bijlage I Bor worden als inrichting in de zin van de Wet milieubeheer (Wm) aangewezen: ‘transformatorstations, met niet in een gesloten gebouw ondergebrachte transformatoren, met een maximaal gelijktijdig in te schakelen elektrisch vermogen van 200 MVA of meer.’

Categorie 20.6 van het Bor, wijst transformatorstations zoals genoemd onder onderdeel 20.1, onder b, aan als vergunningplichtig voor het onderdeel milieu. Echter omdat de transformatoren op platform Beta zijn ondergebracht in een gesloten gebouw, geldt de vergunningplicht op grond van categorie 20.6 bijlage I Besluit omgevingsrecht niet.

Wel is categorie 1.1 van bijlage I Bor van toepassing. Hier worden als inrichting in de zin van de Wm aangewezen, inrichtingen waarin één of meer elektromotoren aanwezig zijn met een vermogen of een gezamenlijk vermogen groter dan 1,5 kW, (bij de berekening van het gezamenlijk vermogen blijft een elektromotor met een vermogen van 0,25 kW of minder buiten beschouwing).

Het platform valt onder de restbepaling van categorie 1.1 en is vergunningplichtig indien de elektromotoren een gezamenlijk vermogen van meer dan 15 MW hebben. Hier wordt niet aan voldaan, waardoor platform Beta niet vergunningplichtig is. In plaats daarvan zijn de algemene regels van het Activiteitenbesluit van toepassing.

De melding Activiteitenbesluit offshore is toegevoegd in bijlage VI.

1.5 Scope aanvraagdocument

De toelichting van de vergunningaanvraag in het kader van de Wet algemene bepalingen omgevingsrecht (Wabo) heeft betrekking op het bouwen van het offshore platform Beta binnen de 12-mijlszone in de Noordzee. Hiervoor wordt een omgevingsvergunning bouwen aangevraagd en een melding Activiteitenbesluit gedaan.

1.6 Planning van het project

In totaal bestaat het project uit twee platforms, onderling verbonden door een back-up kabel en vier 220 kV export kabels. De uitvoering duurt circa 2 jaar. Platform Beta zal in de periode 2019-2022 gerealiseerd worden op zee.

1.7 Leeswijzer

In hoofdstuk twee wordt een nadere toelichting op de scope van de vergunningaanvraag gegeven en in hoofdstuk drie worden de uit te voeren werkzaamheden nader beschreven in het hoofdstuk bouwen.

Bij de toelichting zijn de volgende bijlagen toegevoegd.

Tabel 1.1 Lijst met bijlagen

Bijlage nr.	**Titel**
I	Situatie- en constructietekeningen
II	Method Statement installation HKZ Cable
III	Basic Design Rapport
IV	Certificering
V	Plattegrond brandbeveiliging platform Beta
VI	Melding Activiteitenbesluit
VII	Gelijkwaardigheideisen Bouwbesluit en DNVGL-ST-0145 standaard voor Offshore substations

2

TOELICHTING OP DE SCOPE VAN DE VERGUNNINGAANVRAAG

2.1 Platform Beta

2.1.1 Inleiding

Het doel van de platforms op zee is het bundelen van transportsystemen (kabels) voor de elektriciteit, die door de windturbines wordt opgewekt. De windturbines binnen de kavels van windenergiegebied HKZ worden aangesloten op platforms van TenneT via de zogeheten parkbekabeling. In dit hoofdstuk wordt de realisatie van platform Beta nader toegelicht.

2.1.2 Planning van de realisatie

De platforms Alpha en Beta worden identiek uitgevoerd. Ze bestaan uit een jacket en een topside. Deze worden in een werf op land gebouwd. Vanaf de werf wordt eerst het jacket naar de locatie op zee getransporteerd, waarna deze op z'n plek gezet wordt en verankerd in de zeebodem. Daarna wordt de topside naar de locatie op zee getransporteerd en op het jacket geplaatst.

Voorafgaand aan de plaatsing van het jacket wordt op de zeebodem een verharding met stortsteen aangebracht die het jacket en de zeebodem beschermen tegen erosie en sedimentatie. Door deze laag worden palen geheid om de vier poten van het jacket aan de zeebodem te bevestigen (twee palen per poot, acht palen per jacket).

De voorbereidende werkzaamheden voor platform Beta staan gepland vanaf 2019. In 2022 moet platform Beta in werking zijn.

2.1.3 Ligging

In afbeelding 1.2 is de ligging van platform Beta opgenomen. Het platform bevindt zich op 20 km van de kust. De waterdiepte ter plekke van platform Beta is 21 meter.

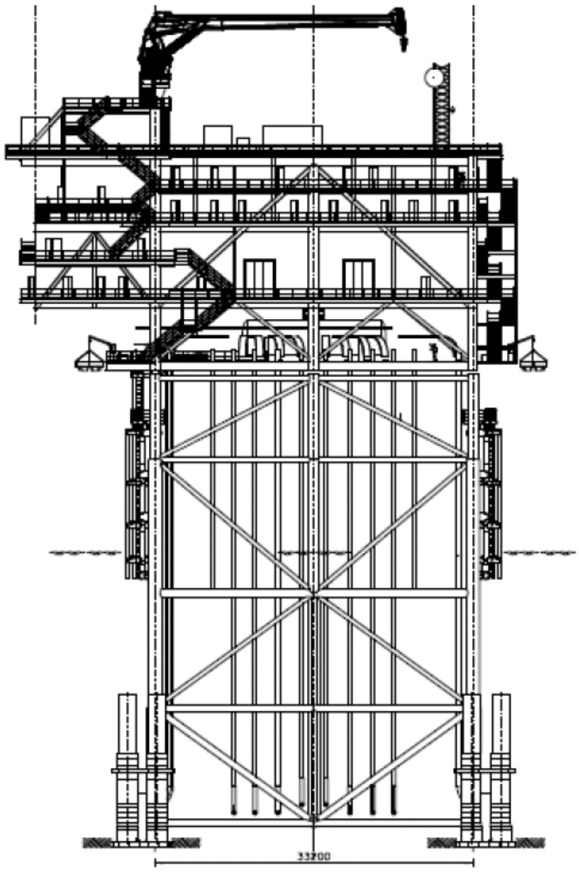
De coördinaten het platform zijn:
- ETRS 1989 UTM Zone 31N: E = 574032.2 N = 5790258.7

2.1.4 Platform Beta

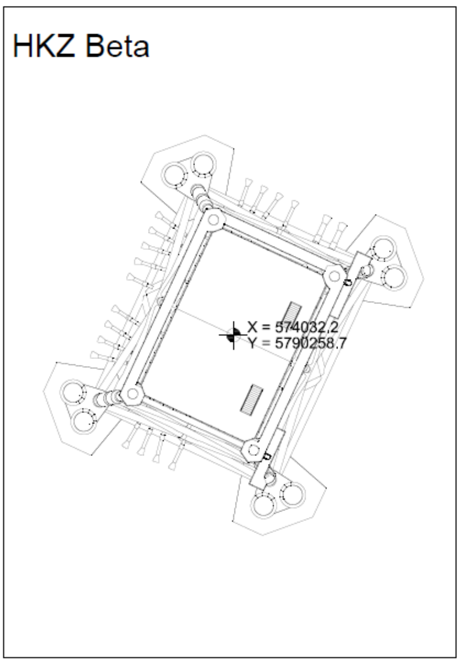
Platform Beta bestaat uit zes dekken, waarvan vijf gewone dekken en één dakdek dat zich boven de twee kamers van de transformatoren bovenin het platform bevindt. Een schematisch ontwerp van het platform wordt in afbeelding 2.1 weergegeven en een bovenaanzicht wordt in afbeelding 2.2 weergegeven. De ontwerptekeningen zijn opgenomen in bijlage I.

Op het platform wordt het spanningsniveau van de parkbekabeling (66 kV) omgezet naar het spanningsniveau van de transportkabels (220 kV).

Afbeelding 2.1 Schematische weergave van een platform



Afbeelding 2.2 Bovenaanzicht platform Beta



3

BOUWEN

Het voornemen bestaat uit de realisatie van een offshore platform. In de volgende paragrafen wordt nadere informatie gegeven over platform Beta.

3.1 Afmetingen bouwwerk

Het platform bestaat uit en wordt gebouwd in twee verschillende onderdelen:
- de stalen draagconstructie, ofwel het jacket;
- de bovenbouw, ook wel topside genoemd.

De stalen draagconstructie heeft een lengte van 35 meter, een breedte van 30 meter en een hoogte van 50 meter. Het gewicht van de stalen draagconstructie bedraagt 3.000 ton. De topside heeft een lengte van 50 meter, een breedte van 25 meter, een hoogte van 30 meter en een gewicht van 4.000 ton. Een specificatie van de maten en het gewicht van beide onderdelen is in tabel 3.1 weergegeven.

Tabel 3.1 Dimensies platform Beta: jacket en topside

	Jacket	Topside
lengte (m)	35	50
breedte (m)	30	25
hoogte (m)	50	30
gewicht (ton)	3.000	4.000
oppervlak (m^2)	1.050	1.250
inhoud (m^3)	52.500	37.500

In bijlage I zijn plattegronden, een detailtekening en verschillende aanzichten van het platform opgenomen. Bijlage III bevat achtergrondinformatie betreffende de constructie, kleur- en gebruikte materialen.

De eisen uit het Bouwbesluit zijn met de DNVGL-ST-0145 standaard voor Offshore substations (bijlage III) vergeleken (zie, bijlage VII). Het Bouwbesluit beschrijft technische bouwvoorschriften uit oogpunt van veiligheid (afdeling 2) die ook worden behandeld in de DNVGL-ST-0145 standaard. Door certificering van het ontwerp tegen de DNVGL-ST-0145 standaard worden systematisch alle bouwvoorschriften van het Bouwbesluit behandeld en wordt tenminste dezelfde mate van veiligheid bereikt. TenneT verzoekt dan ook gebruik te kunnen maken van het gelijkwaardigheidsprincipe in het bouwbesluit en de Offshore Veiligheidsvoorschriften en andere bouwvoorschriften die als standaard zijn geformuleerd door DNV GL als gelijkwaardige maatregel te mogen treffen.

3.2 Aanleg

3.2.1 Jacket

Het jacket wordt samen met de benodigde heipalen door een ponton naar de betreffende locatie gebracht. Daar wordt het jacket met behulp van een kraanschip op de gewenste plek neergezet (zie afbeelding 3.1). Aan de hoekpunten van het jacket zitten geleidingsframes waar de heipalen in kunnen worden geheid. De palen dienen van de ponton te worden getild en in de geleidingsframes te worden geplaatst. Daarna kunnen met een opzetstuk en een heihamer de heipalen de zeebodem in worden geheid tot op de juiste diepte. Vervolgens wordt het jacket horizontaal uitgelijnd. De installatie van de funderingen voor een platform duurt ongeveer een week. Er zal kathodische bescherming worden aangebracht, waarschijnlijk aluminium kathodes, in ieder geval geen zink. Nadat het jacket is geïnstalleerd worden de kabels ingetrokken op het kabeldek en kan daarna de bovenbouw er bovenop worden geplaatst.

Erosie rondom fundering

Om te voorkomen dat de bodem rondom de fundering erodeert wordt er gebruik gemaakt van erosie beschermend materiaal (scour protection). Dit wordt aangelegd in de vorm van een grindlaag en daarop stenen tot 20 meter rondom het platform en tot 100 meter lengte vanuit het platform met zakken stenen (rock-bags) op inkomende en uitgaande kabels.

Afbeelding 3.1 Installatie Jacket

3.2.2 Topside

De bovenbouw wordt in de werf gebouwd en alle onderdelen (transformatoren, de schakelapparatuur en de beveiligingsapparatuur) zijn dus geïnstalleerd. De eerste commissioning, de onshore commissioning, vindt eveneens plaats in de werf. Wanneer de bovenbouw gereed is, wordt deze in zijn geheel naar de locatie op zee vervoerd. Evenals bij het jacket is de bovenbouw voorzien van hijsogen. Deze worden gebruikt als de bovenbouw op het al geplaatste jacket wordt gehesen (zie afbeelding 3.2). Indien dit is gebeurd wordt de bovenbouw vastgemaakt op het jacket met behulp van bouten, de zogenaamde hook-up. Ook hier wordt na afloop een inspectie uitgevoerd of de bovenbouw goed is geïnstalleerd. De installatie van de topside van een platform duurt ongeveer een week. Het is de bedoeling dat zeewater de bovenbouw niet kan bereiken. Daarom wordt de bovenbouw op ongeveer 15 meter boven HAT (Highest Astronomical Tide) niveau geplaatst.

Afbeelding 3.2 Installatie van de topside

3.3 Ruimtelijke inpassing

Ter plekke van de beoogde locatie van platform Beta is geen bestemmingsplan of ander ruimtelijke toetsingskader vastgesteld. De ruimtelijke inpasbaarheid van platform Beta wordt beoordeeld binnen de kaders van de watervergunning.

3.4 Bodem

Ter plekke van de beoogde locatie van platform Beta is de Waterwet van toepassing. De zeebodem is een waterbodem en maakt onderdeel uit van het waterstaatswerk Noordzee. De kwaliteit van de waterbodem wordt beoordeeld binnen de kaders van de watervergunning.

3.5 Kosten

De inschatting van de kosten voor de constructie van platform Beta is onder te verdelen in kosten voor het jacket en kosten voor de topside:

- jacket: circa EUR 17.000.000,--;
- topside: circa EUR 35.000.000,-- .

4

LITERATUURLIJST

1 Sociaal Economische Raad, Energieakkoord voor duurzame groei, 2013.
2 Ministerie van Infrastructuur en Milieu en ministerie van Economische Zaken, Routekaart voor windenergie op zee, brief d.d. 26 september 2014, Den Haag, 2014.
3 Ministerie van Economische Zaken en ministerie van Infrastructuur en Milieu, Wet windenergie op zee, Den Haag, 2015.
4 Ministerie van Economische Zaken. Wet van 23 maart 2016 tot wijziging van de Elektriciteitswet 1998 (tijdig realiseren doelstellingen Energieakkoord). Staatscourant, 2016-116, Den Haag 2016.

Bijlage(n)

I

BIJLAGE: SITUATIE- EN CONSTRUCTIETEKENINGEN

OFFSHORE GRID NL

E 3.4.14.

Document Title:

Standard Offshore Substation Jacket Structure – structural drawings

(21 drawings)

01	15-01-2016	Issued for ITT			
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Rev.	Revision date (DD-MM-YYYY)	Reason for issue	Prepared by	Verified by	Approved by

Project no.: 1100015665

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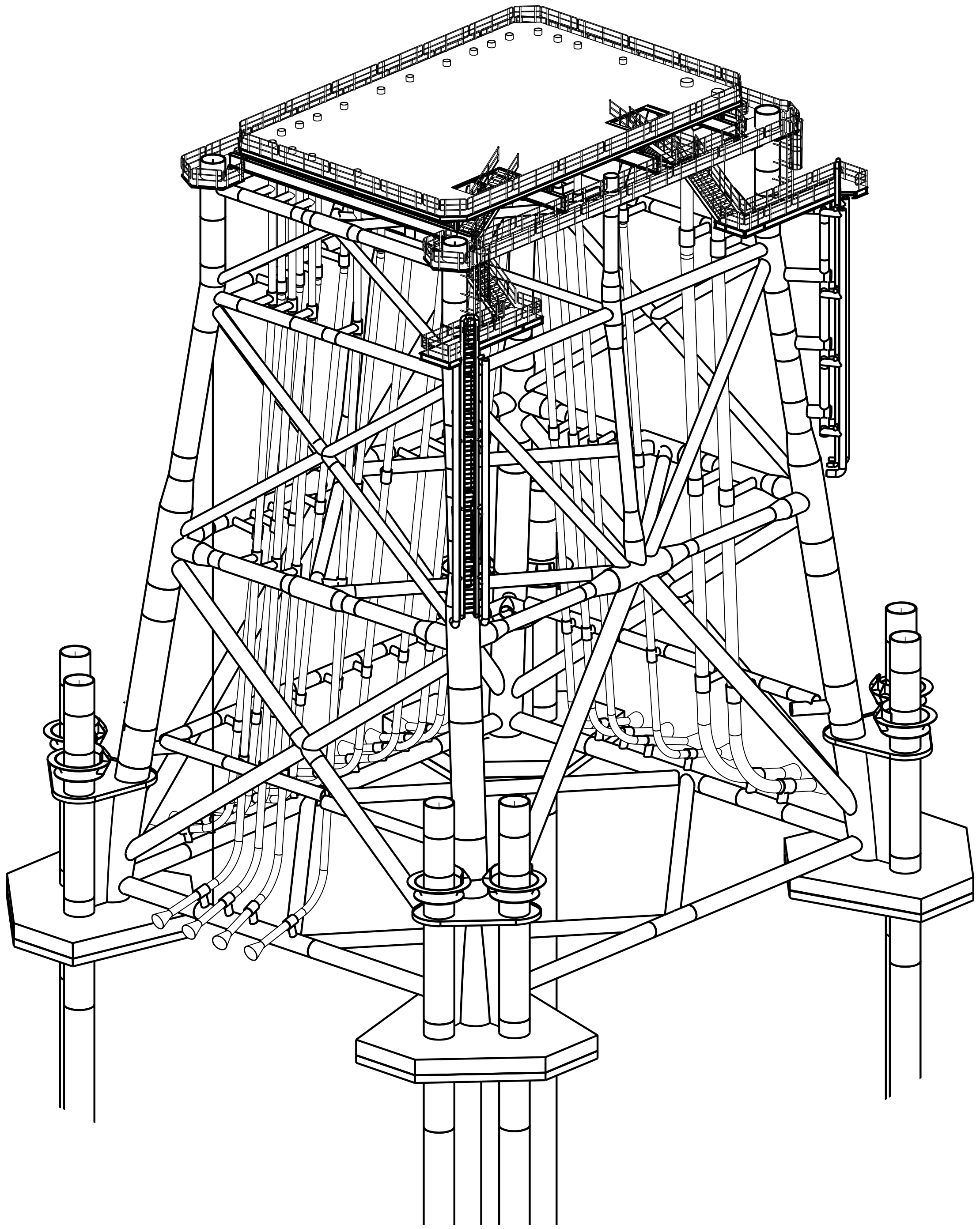
TenneT Document No.:

ONL-TTB-00209

NOTES

TENNET
STANDARD 700 MW AC OFFSHORE SUBSTATION
JACKET STRUCTURE



PREPARED BY:

RAMBOLL

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Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
ISOMETRIC VIEW

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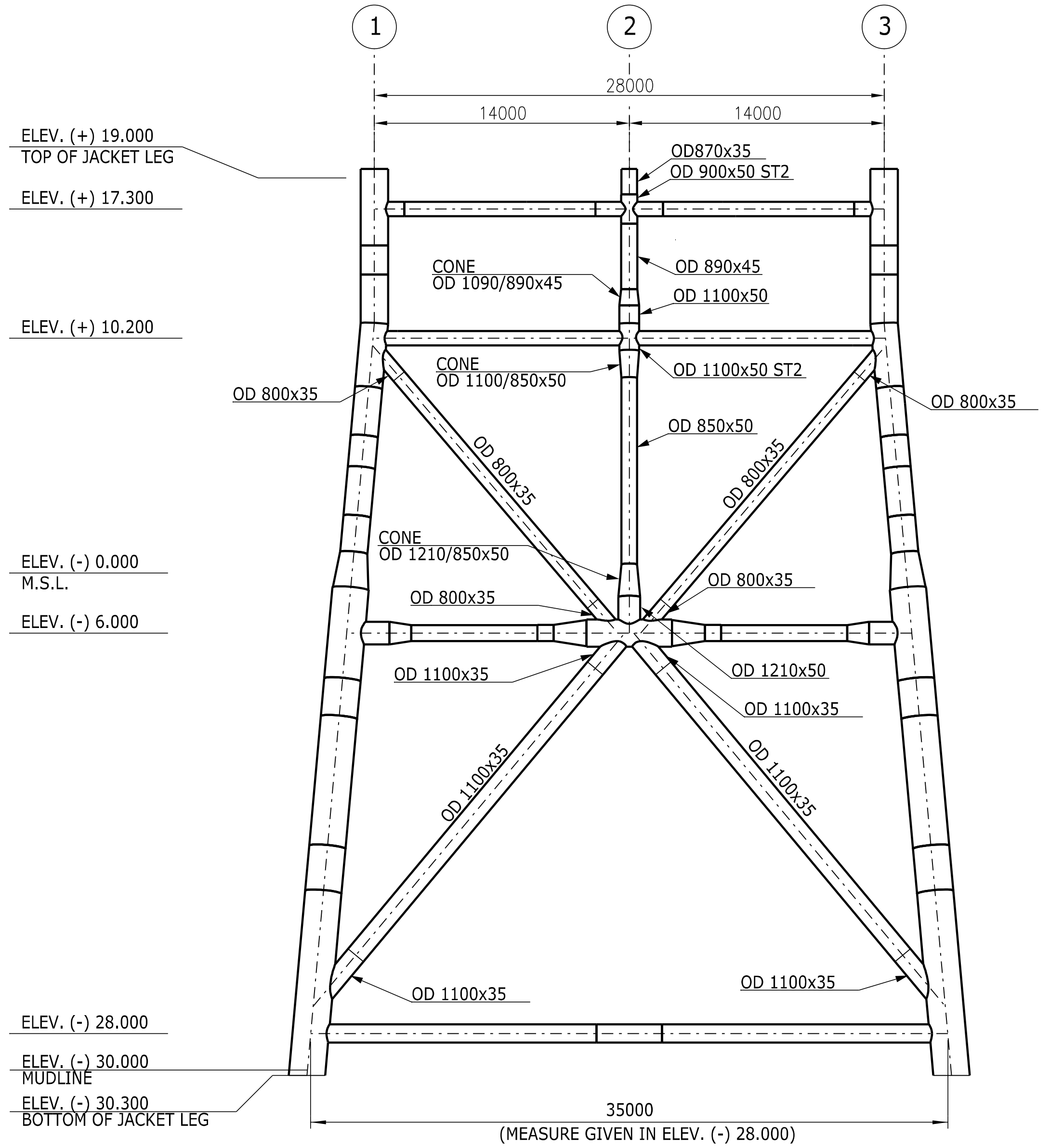

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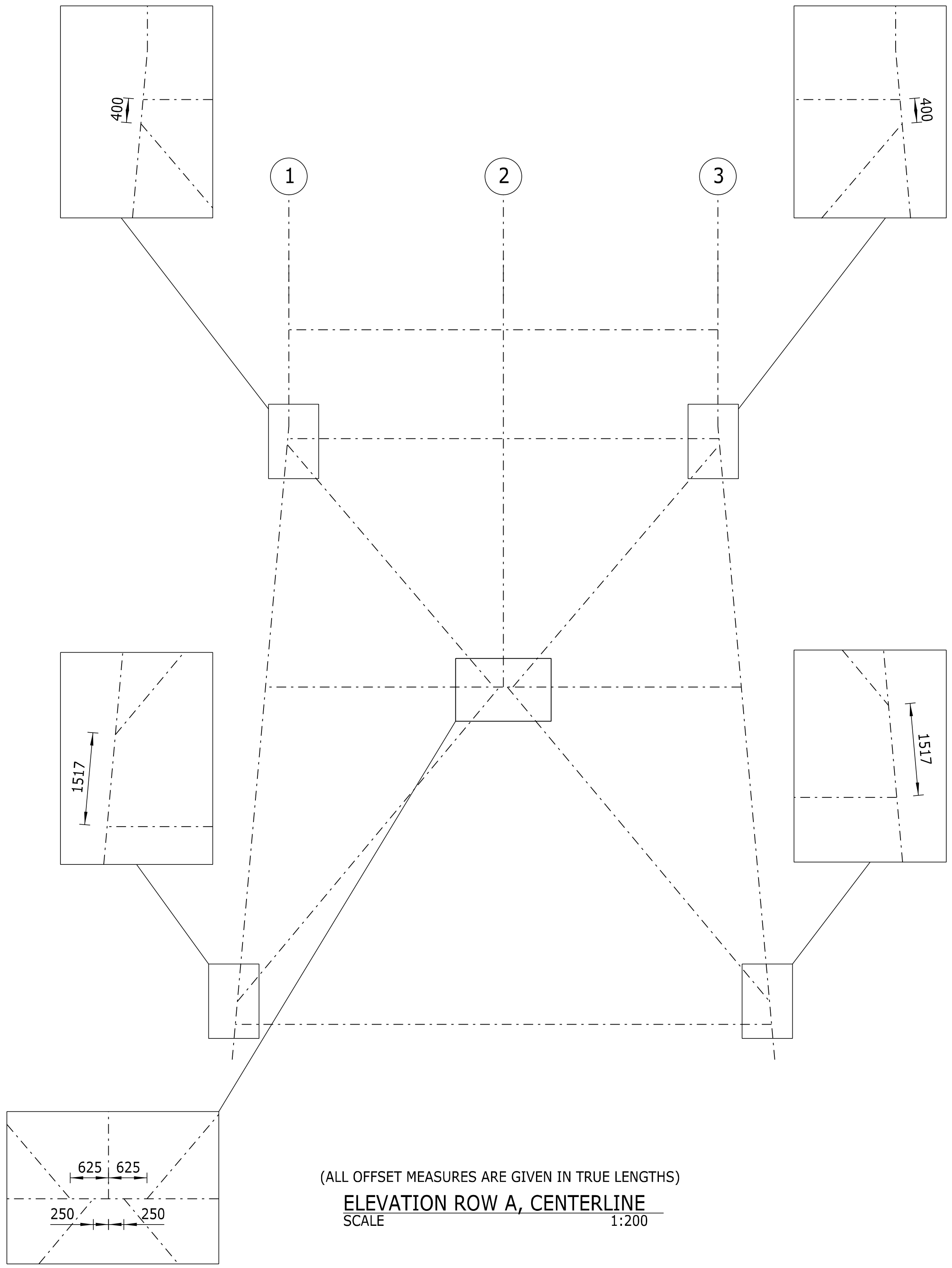

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SCALE 1:200

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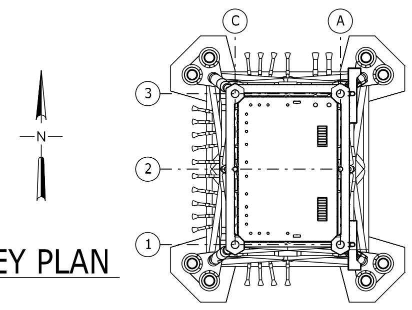

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Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
MAIN FRAME BRACING
ROW A

Scale	Size	Drawing no.	Rev.
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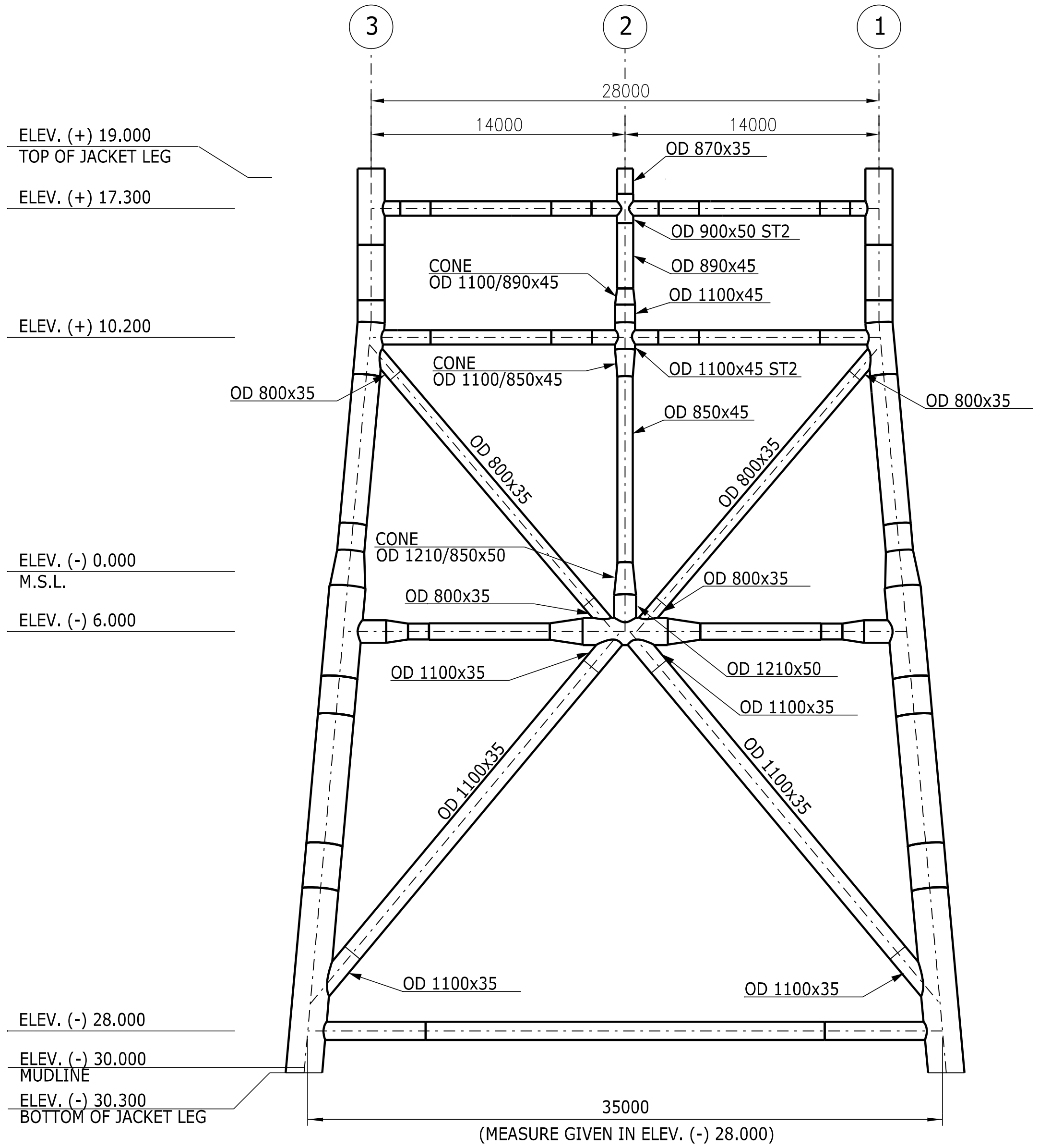

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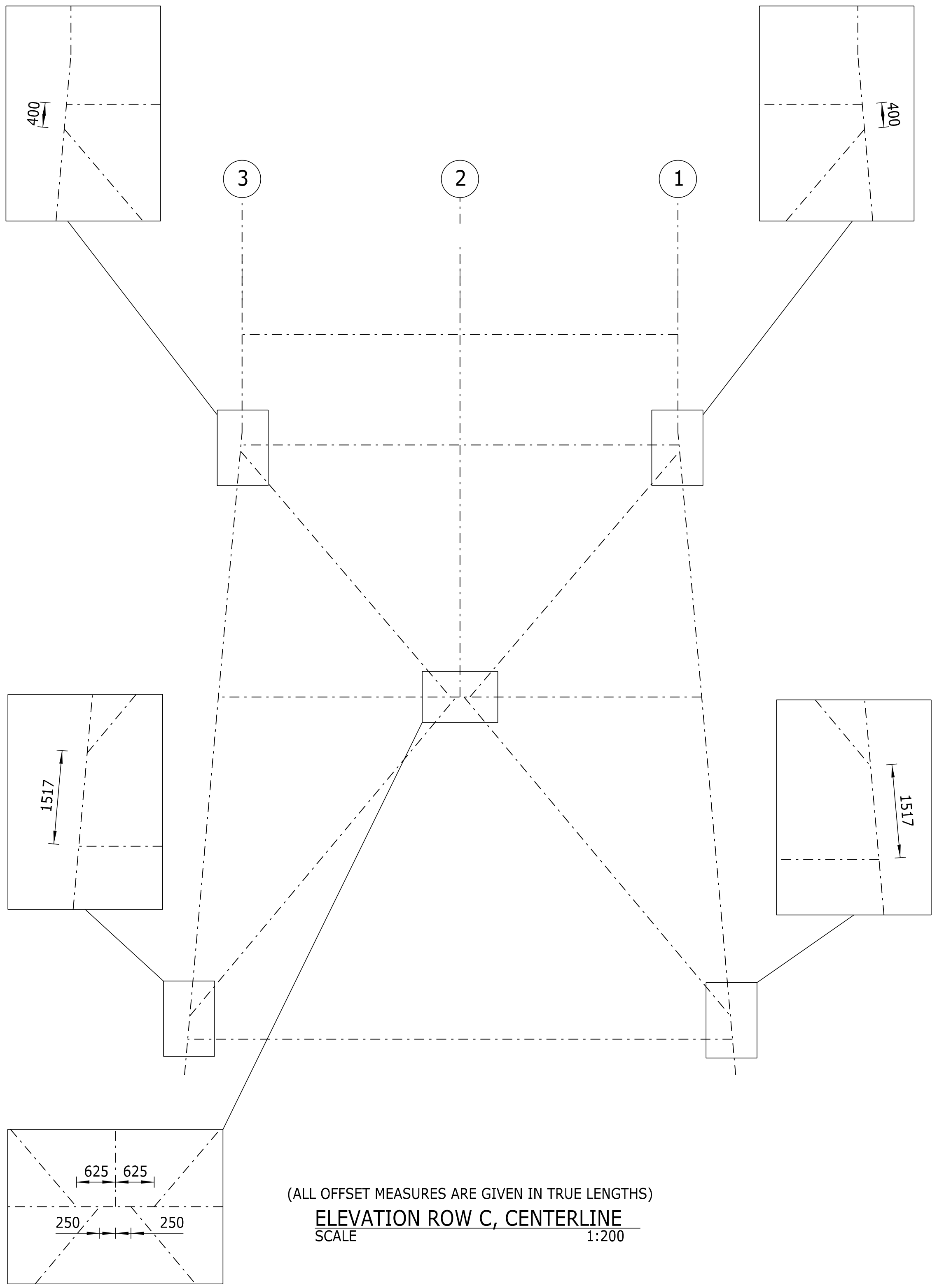

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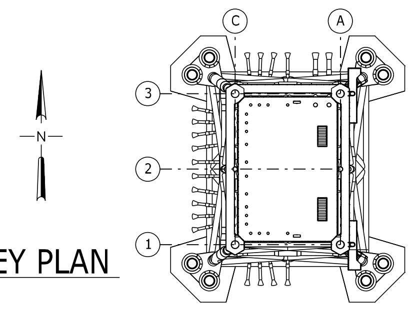

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STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
MAIN FRAME BRACING
ROW C

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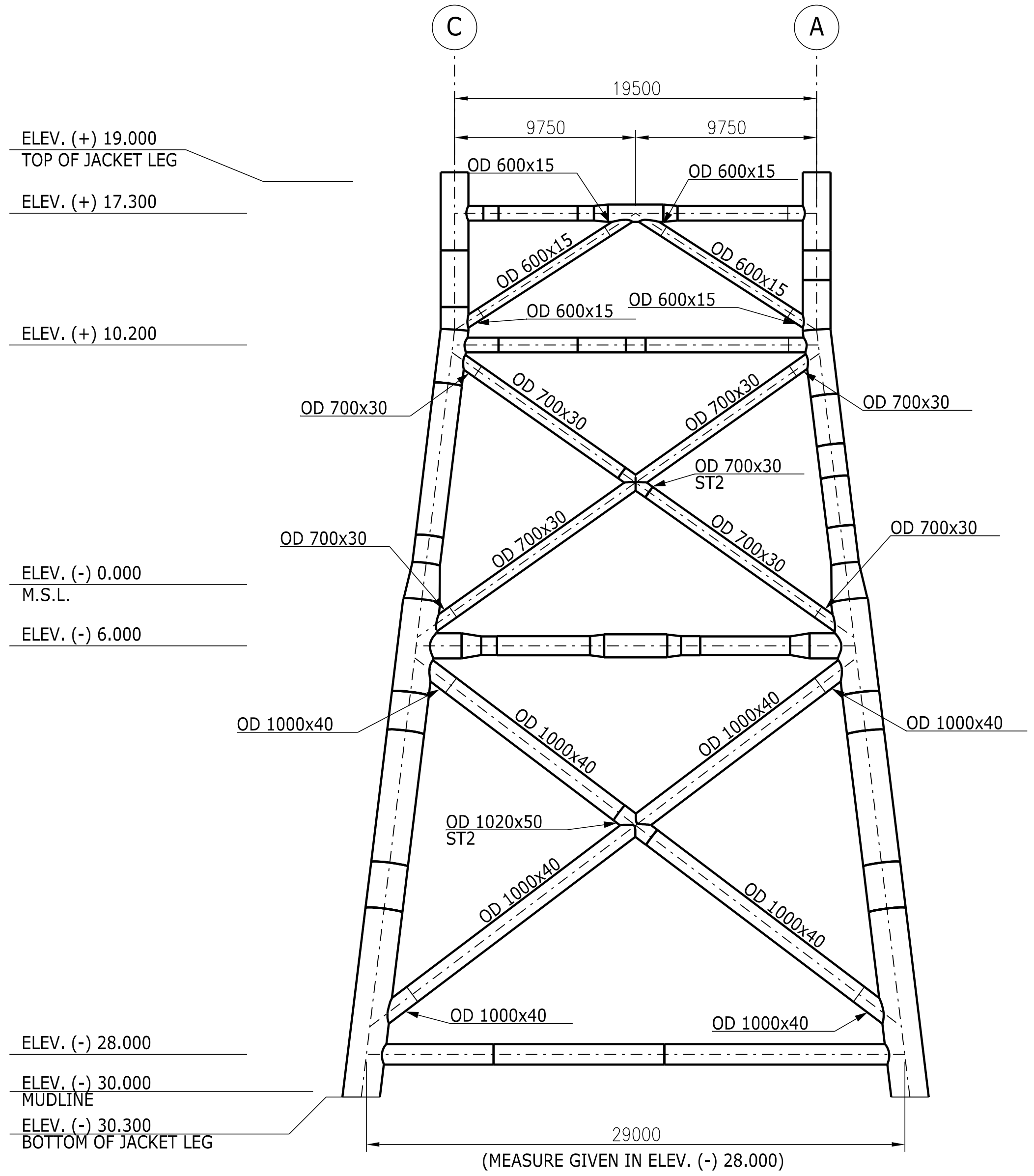

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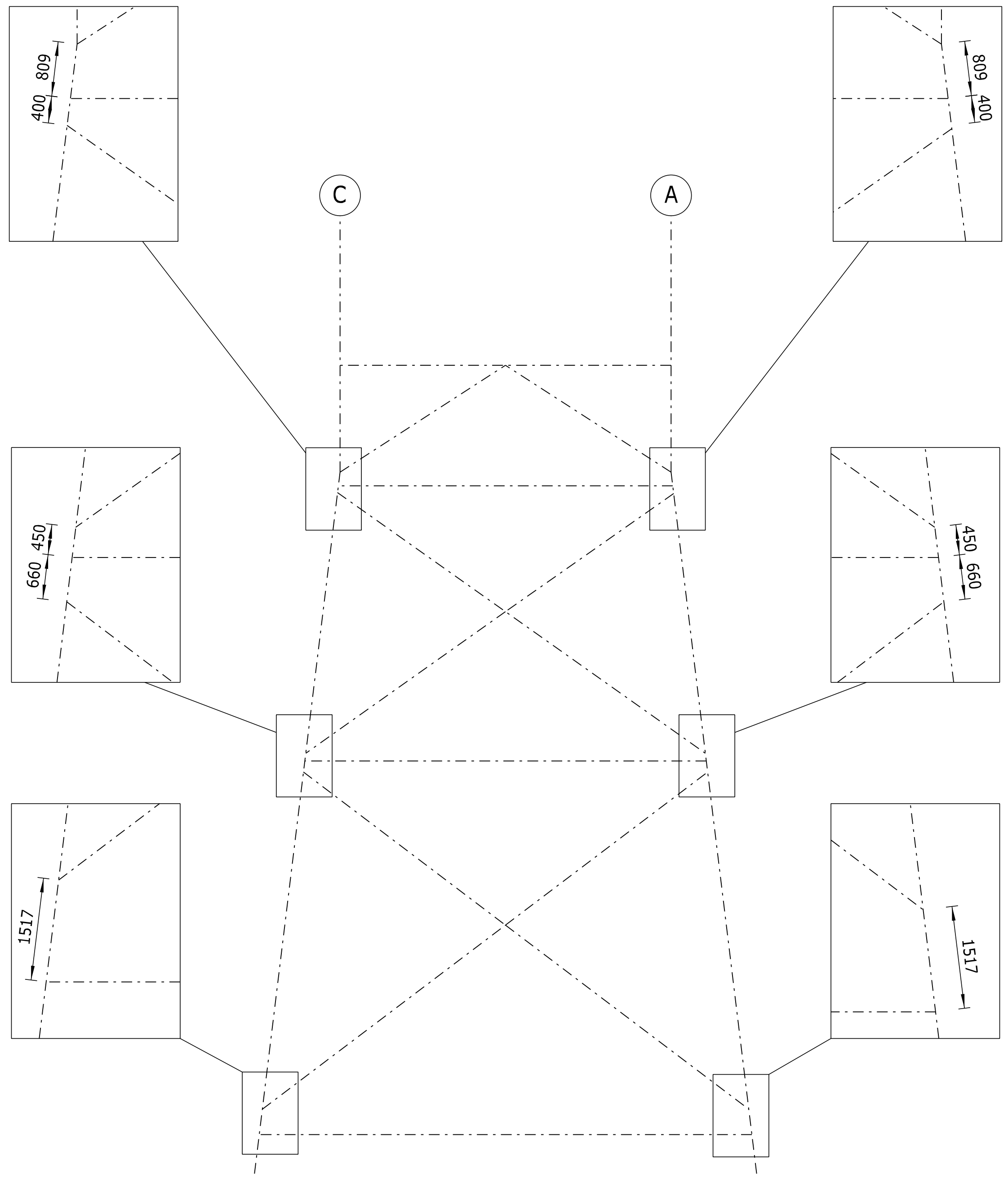

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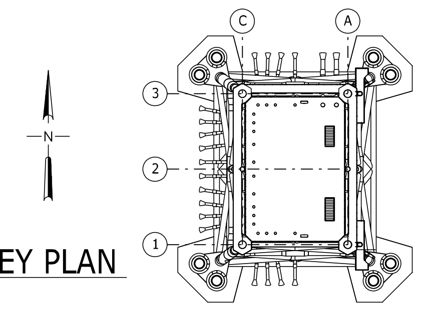

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Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
MAIN FRAME BRACING
ROW 1

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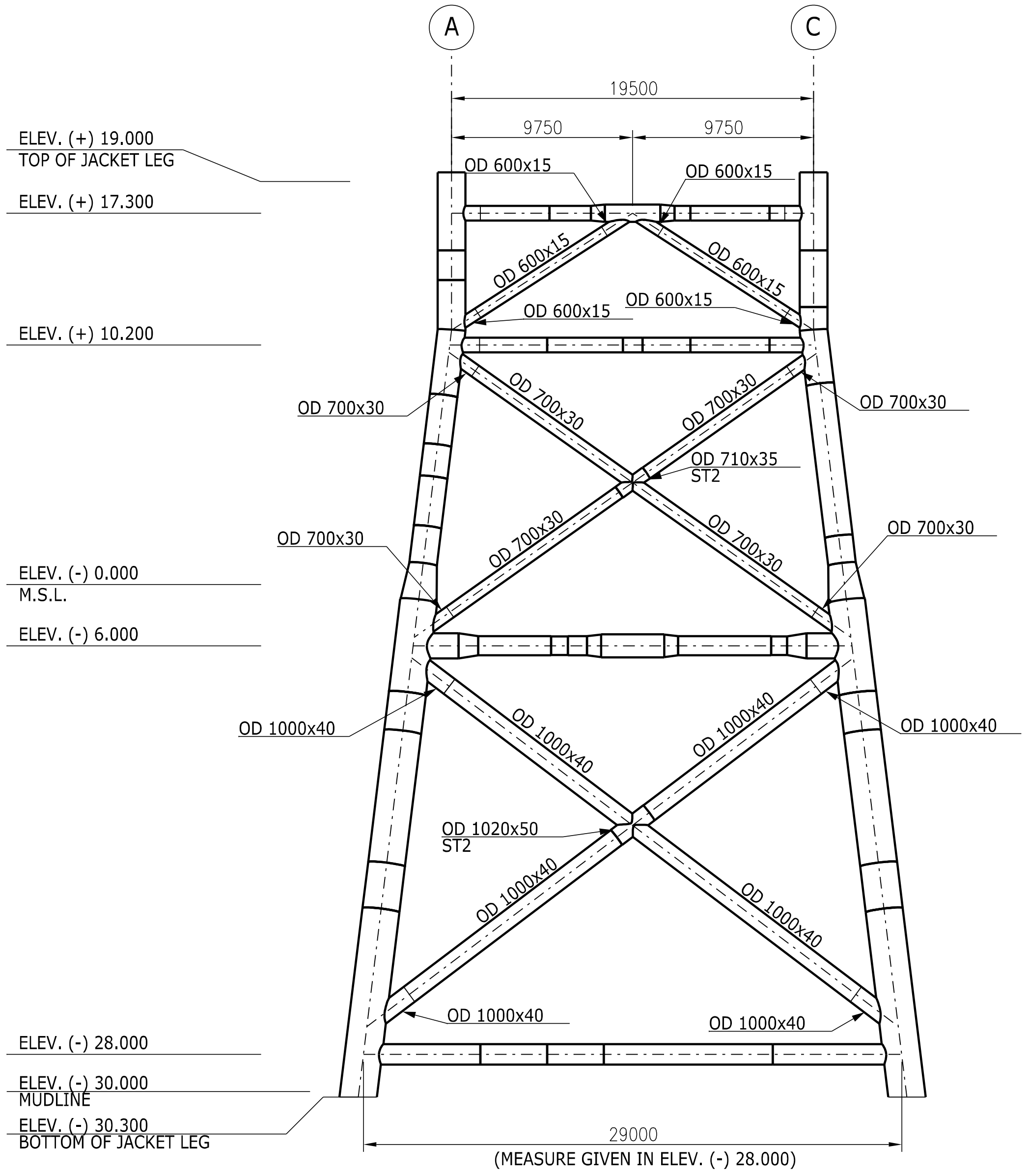

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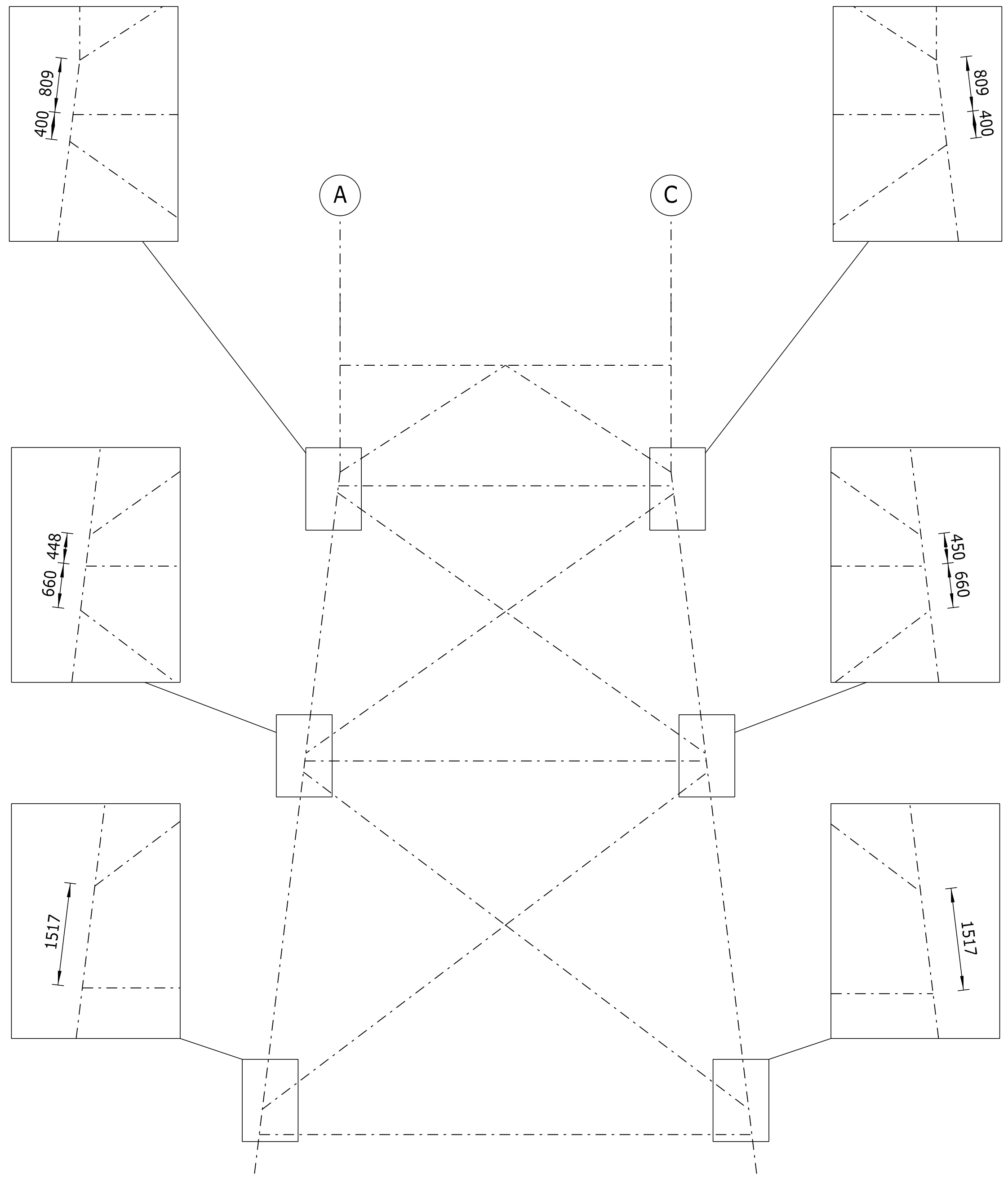

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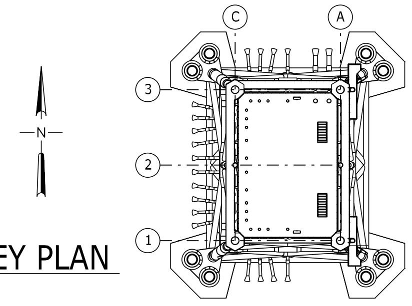

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Job no. 1100015665

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STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
MAIN FRAME BRACING
ROW 3

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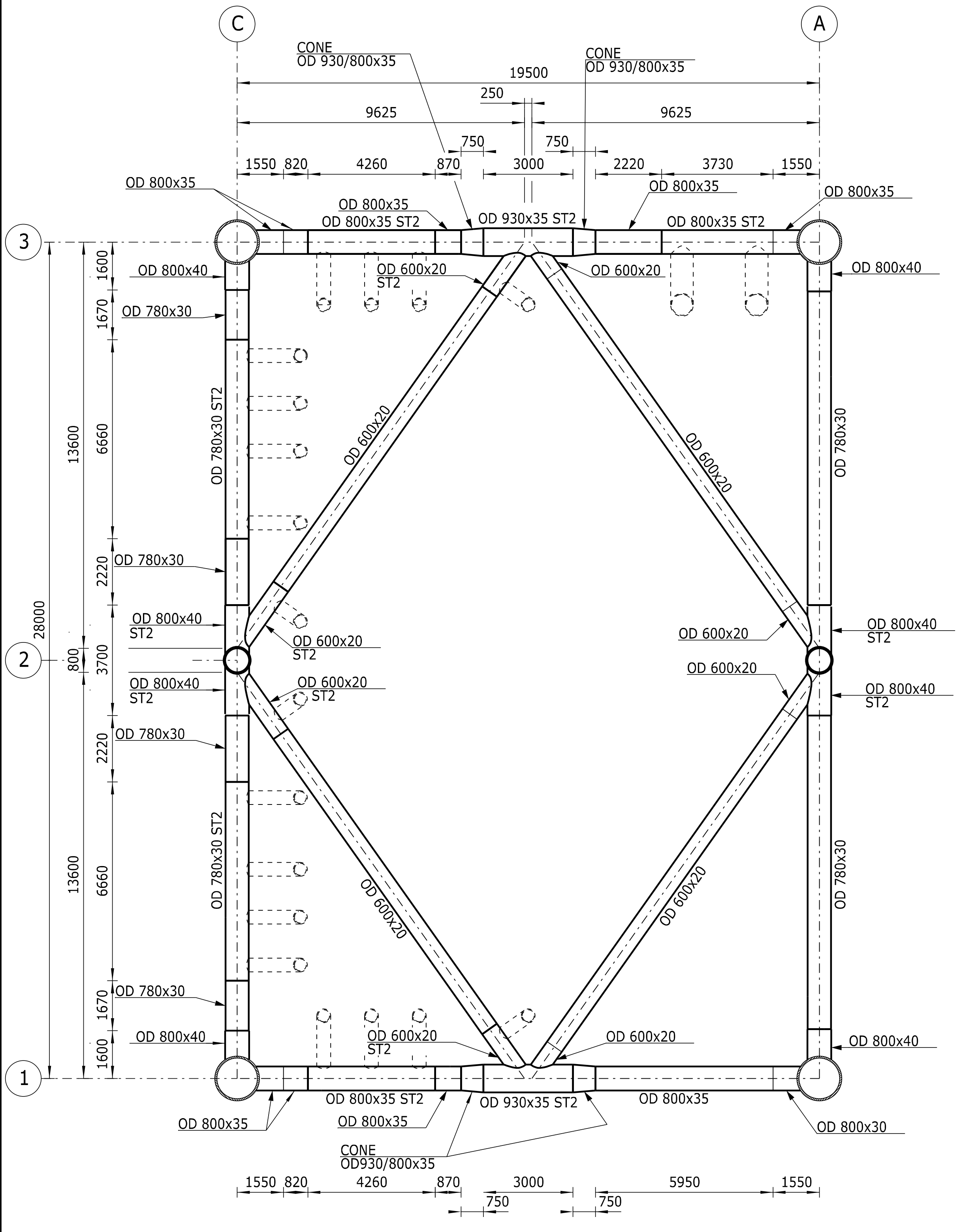

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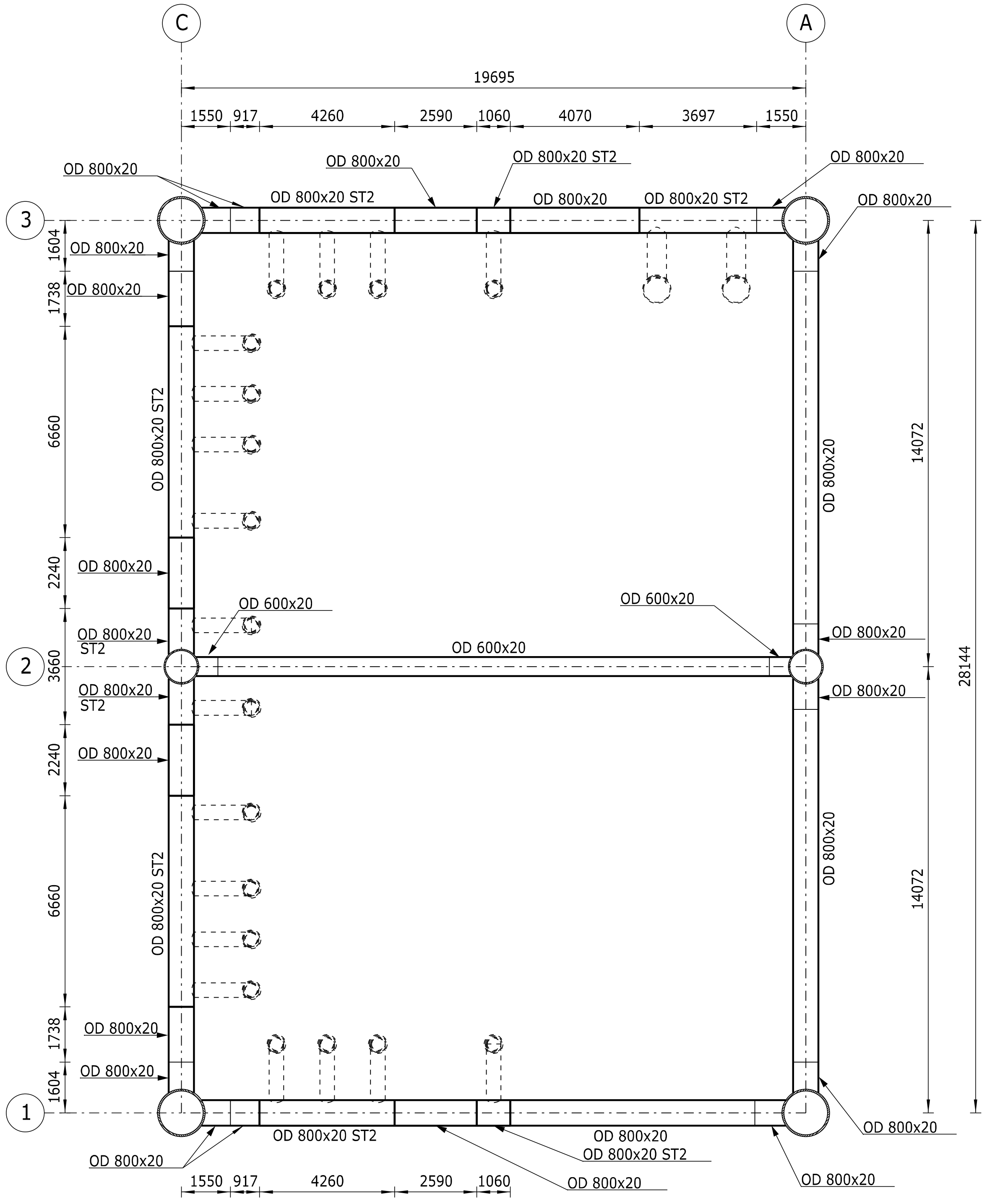

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SCALE 1:100

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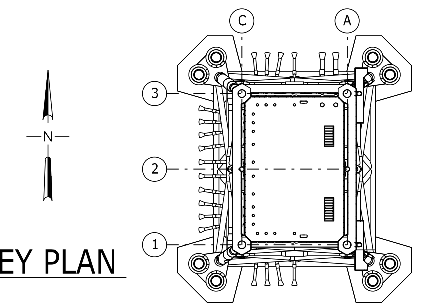

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STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

JACKET STRUCTURE
PLANS ELEV. (+)17.300 AND ELEV. (+)10.200

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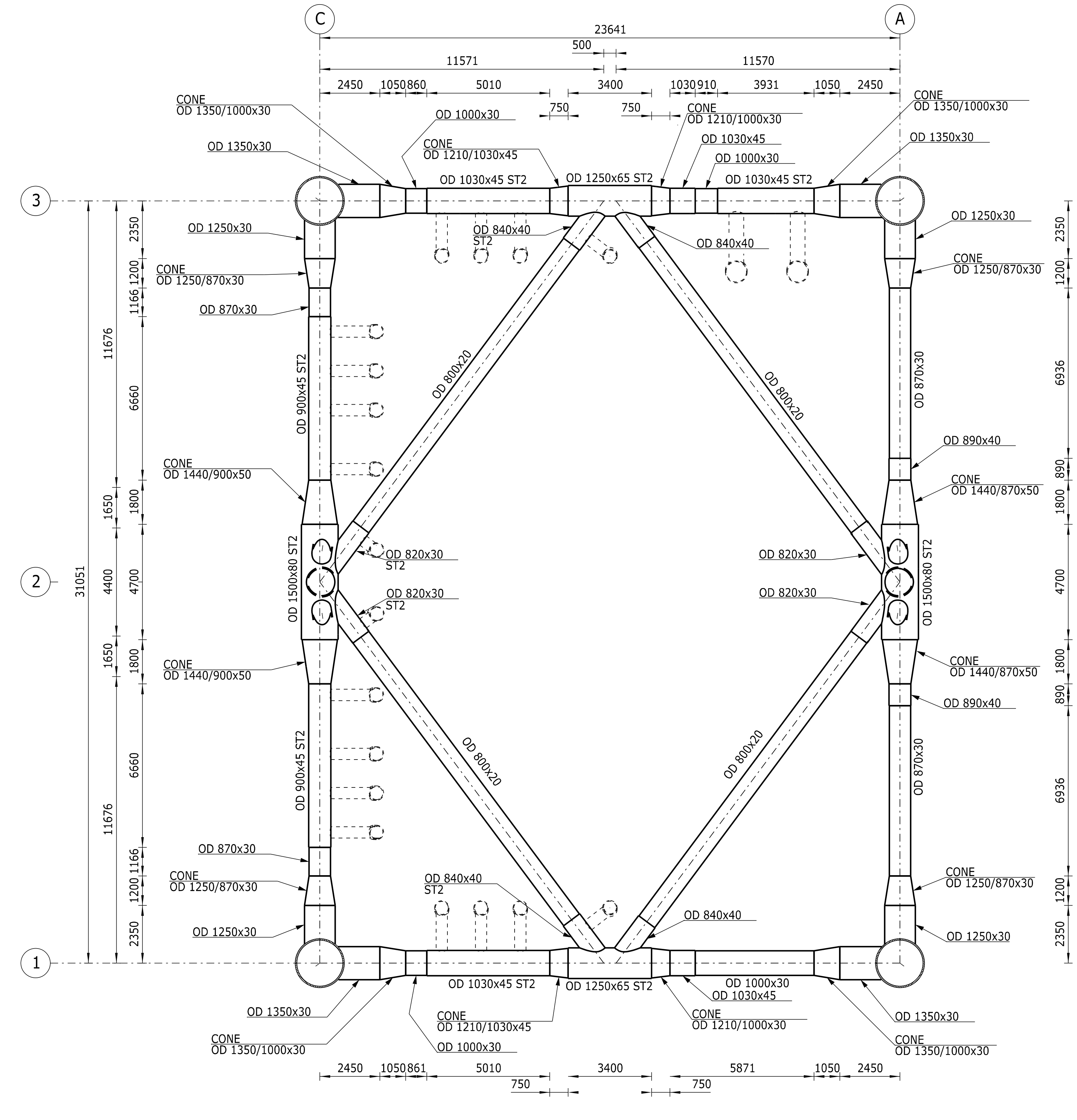

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SCALE 1:100

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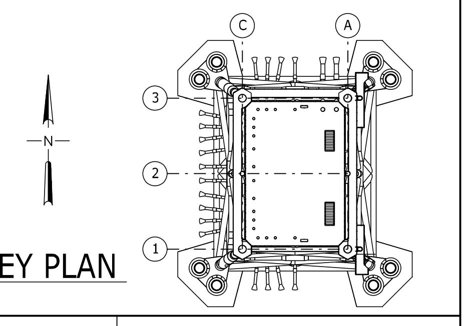

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Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
PLAN ELEV. (-)6.000

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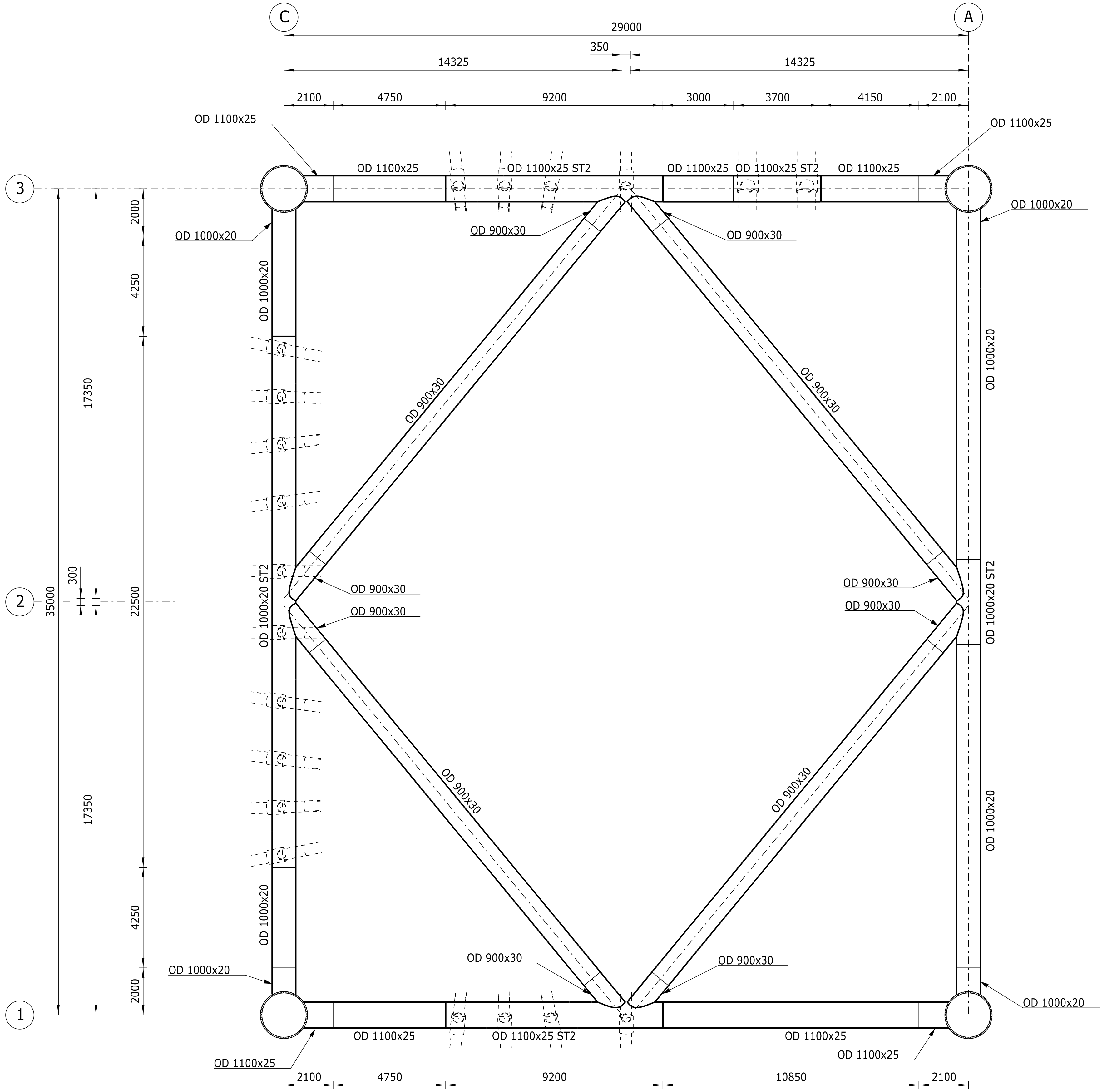

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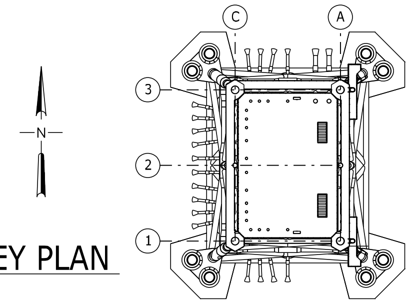

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TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
PLAN ELEV.(-)28.000

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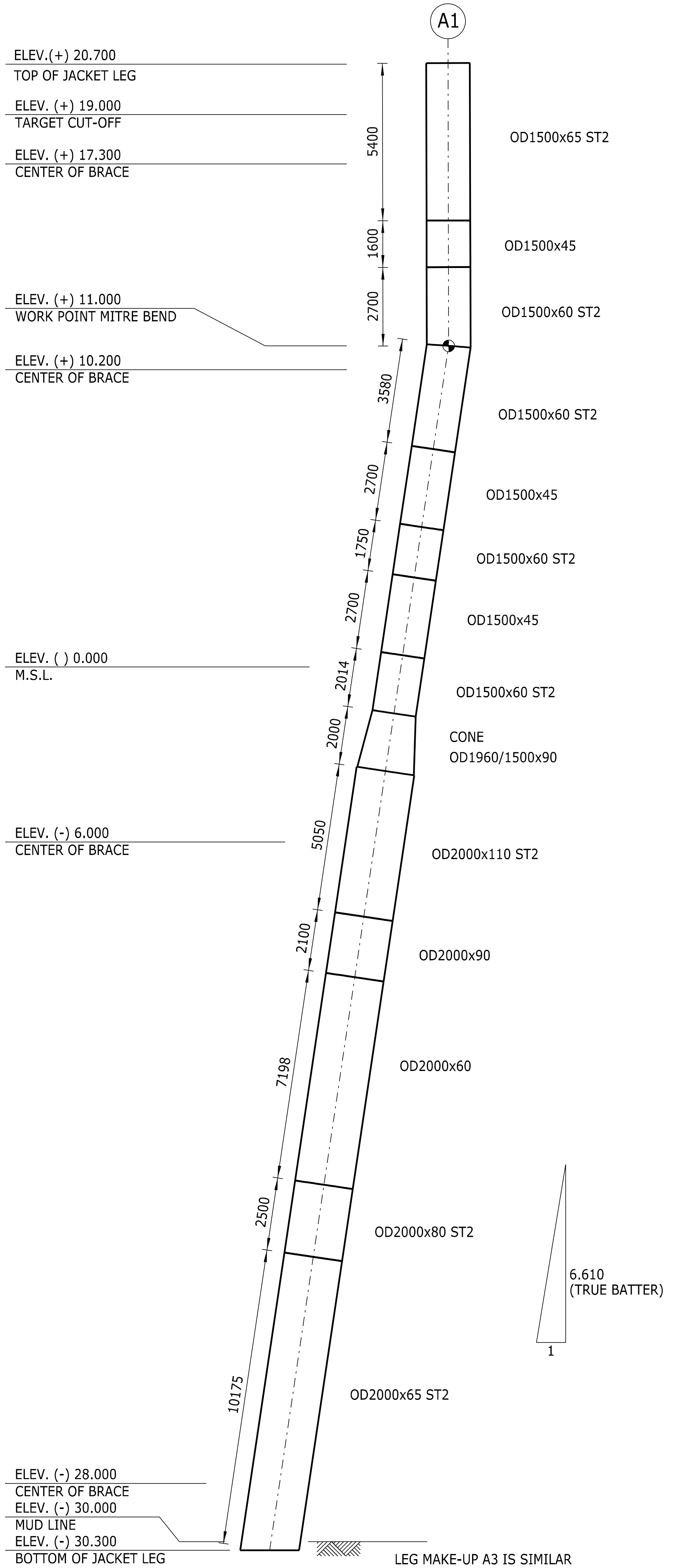

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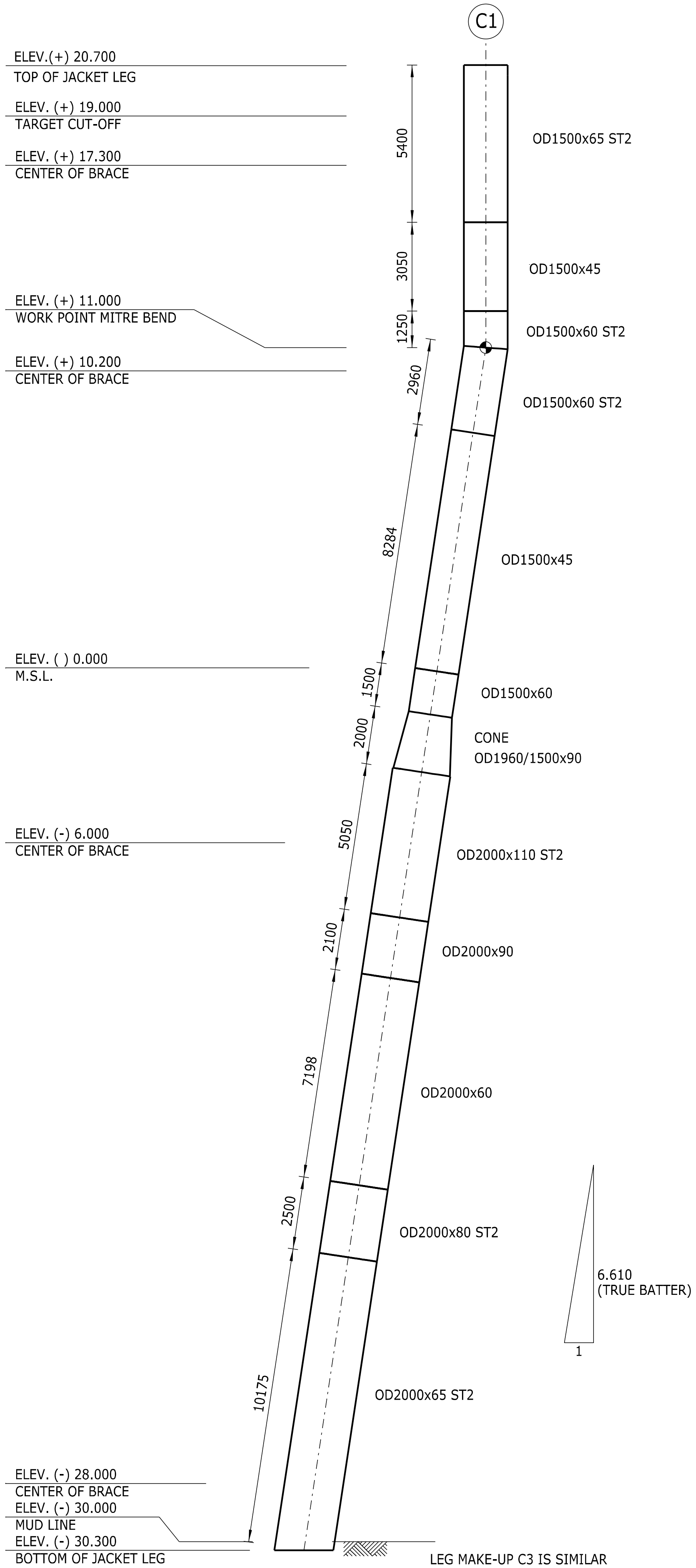

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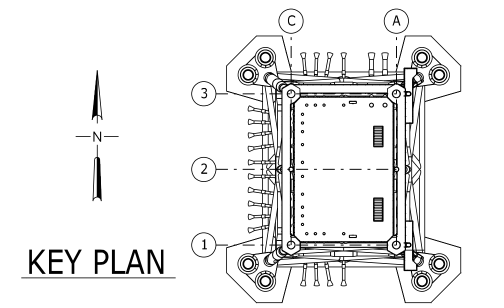
5. WELD IN CONICAL TRANSITIONS AND NODAL JOINTS TO BE FULL PENETRATION DOUBLE SIDED U.N.O.
6. ALL STEEL TO BE ST1 U.N.O.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/BBR	STC	MXH	ISSUED FOR COMMENTS

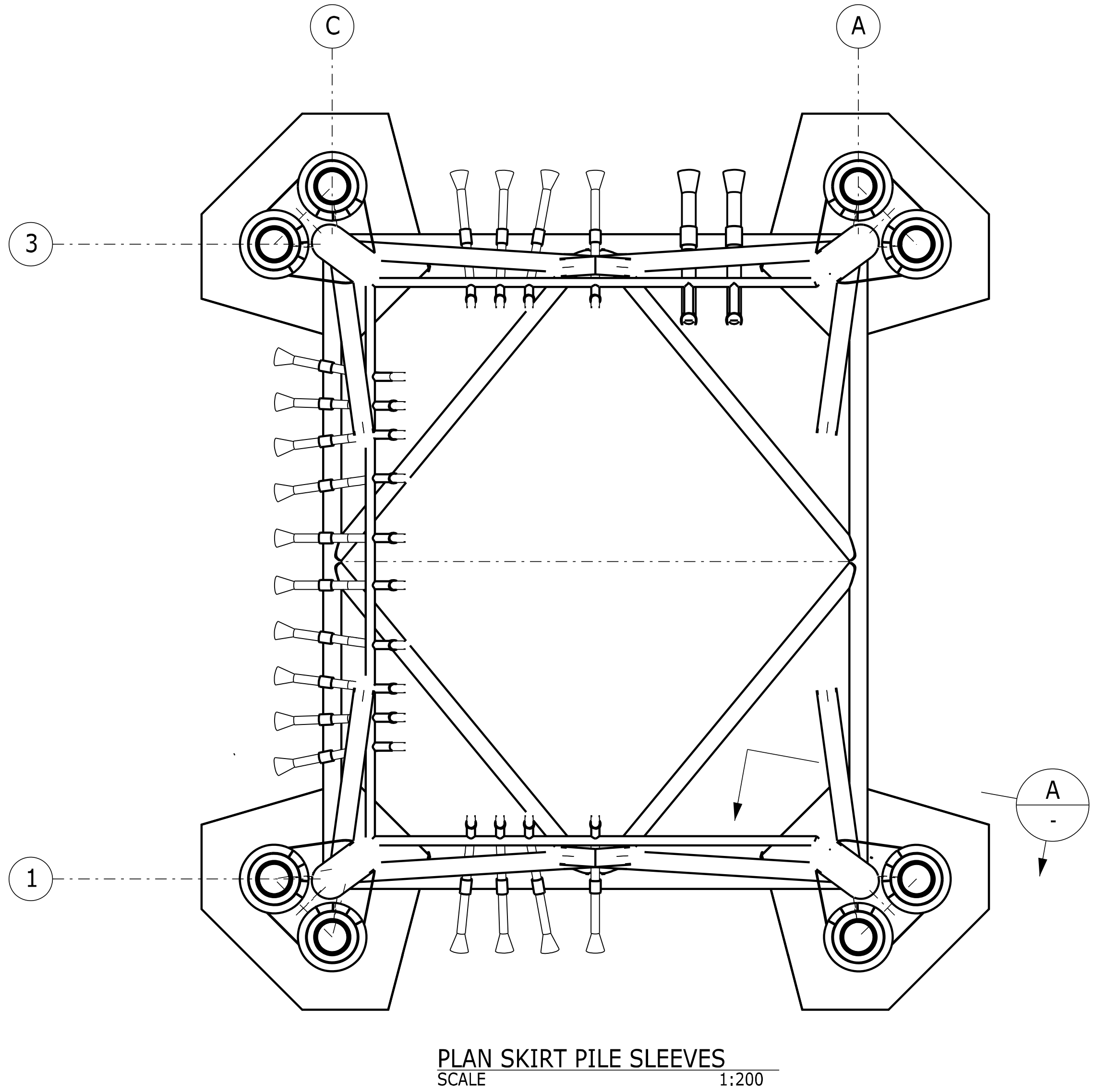
Job no. 1100015665

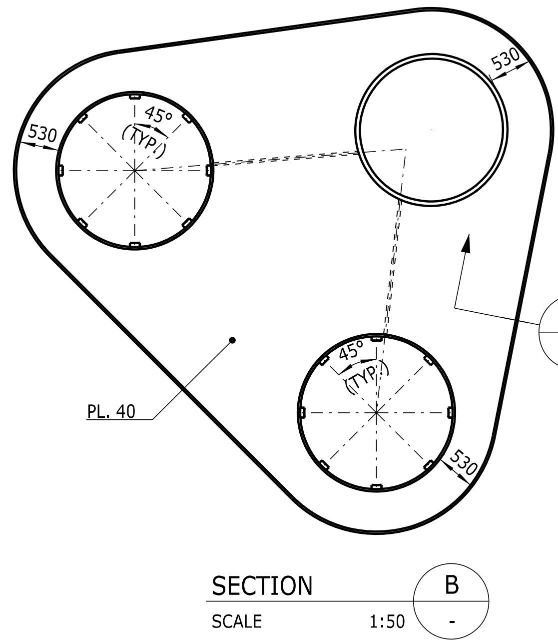
TenneT
Taking power further

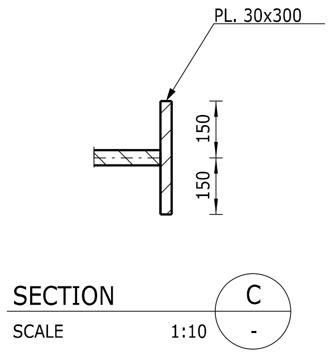
STANDARD 700MW AC OFFSHORE SUBSTATION

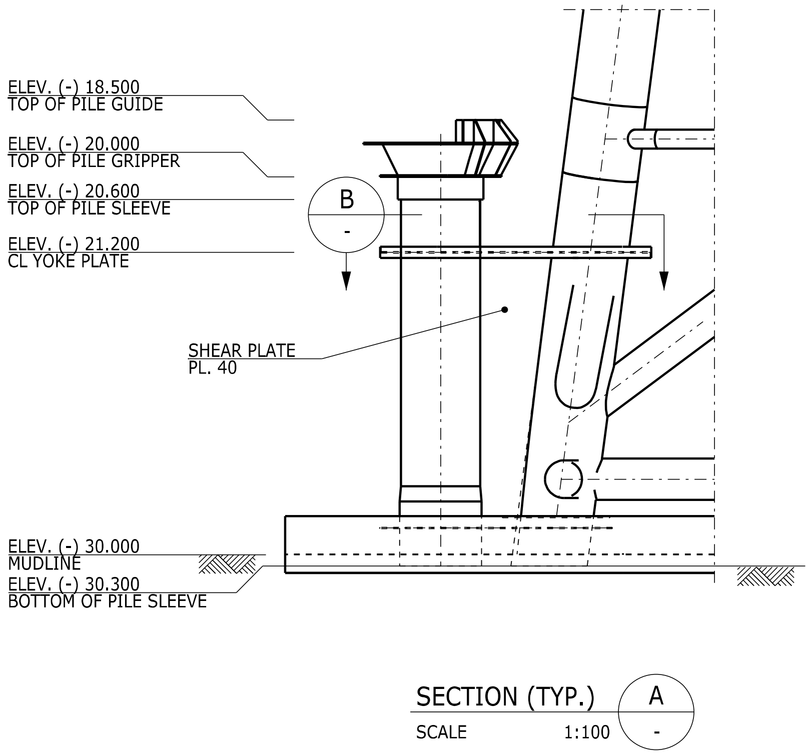
Title
OFFSHORE GRID NL
JACKET STRUCTURE
LEG MAKE-UP

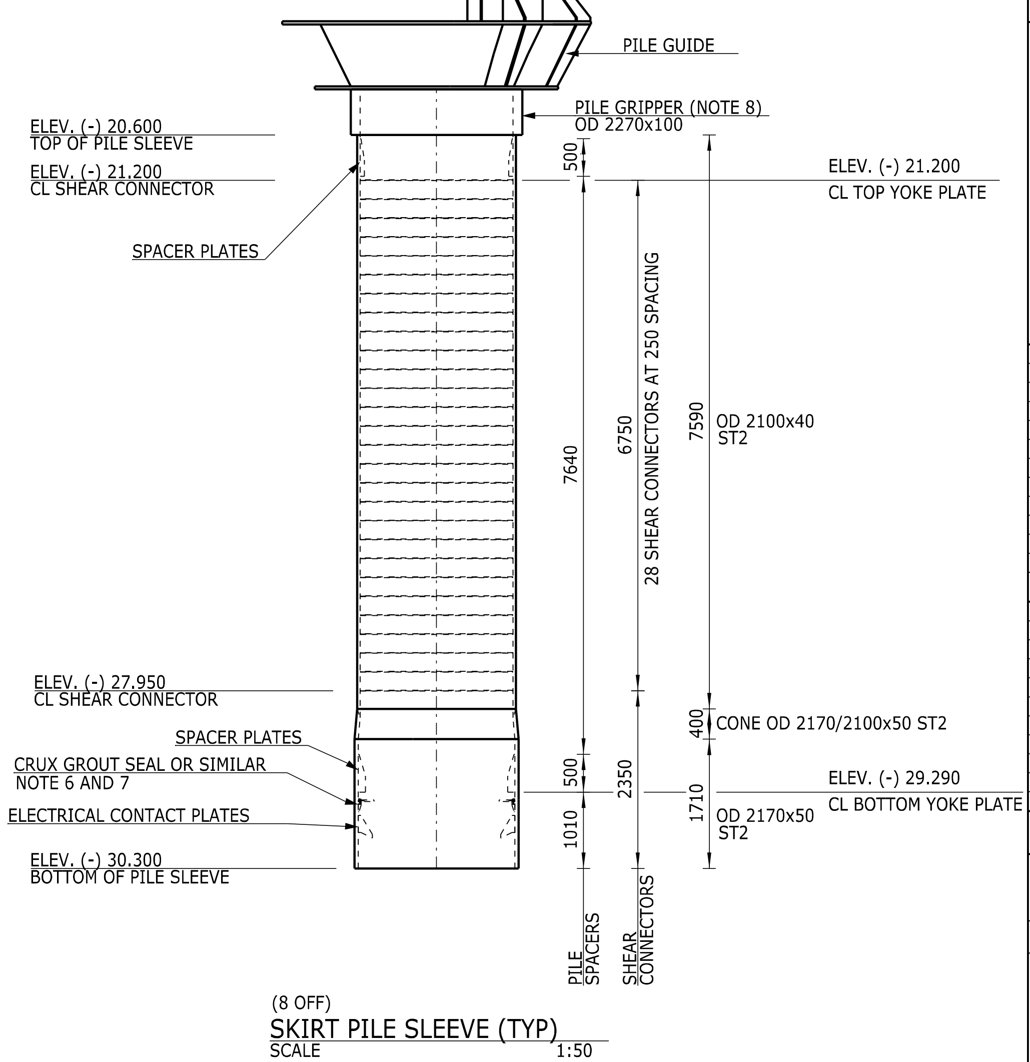
Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-09	0





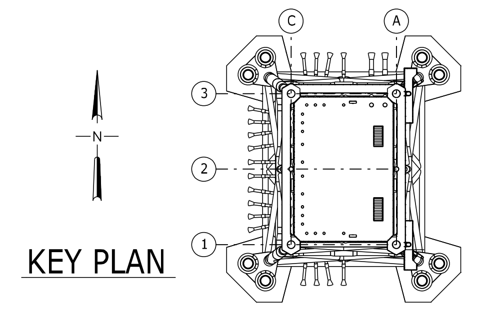






NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 SPECIAL STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.1 ACC. TO EN 10204 U.N.O.
3. WELDS TO BE INSPECTION CATEGORY I ACC. TO DNV-OS-C101 U.N.O.
4. WELDS TO BE DOUBLE SIDED FULL PENETRATION WELD U.N.O.
5. ALL STEEL TO BE ST1 U.N.O.
6. GROUT SEAL TYPE/FABRICATOR SUBJECT TO EMPLOYER APPROVAL. CONTRACTOR TO VERIFY THAT PILE SPACERS GIVE ADEQUATE PROTECTION OF SEAL ATTACHMENT DURING PILE STABBING.
7. GROUT SEAL SUPPLIER TO VERIFY THAT SEAL TYPE SUITS ID OF PILE SLEEVE.
8. ONE PILE GRIPPER TO BE ARRANGED AT EACH PILE CLUSTER.
THE THICKNESS OF PILE GRIPPER CAN IS ONLY INDICATIVE.



Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

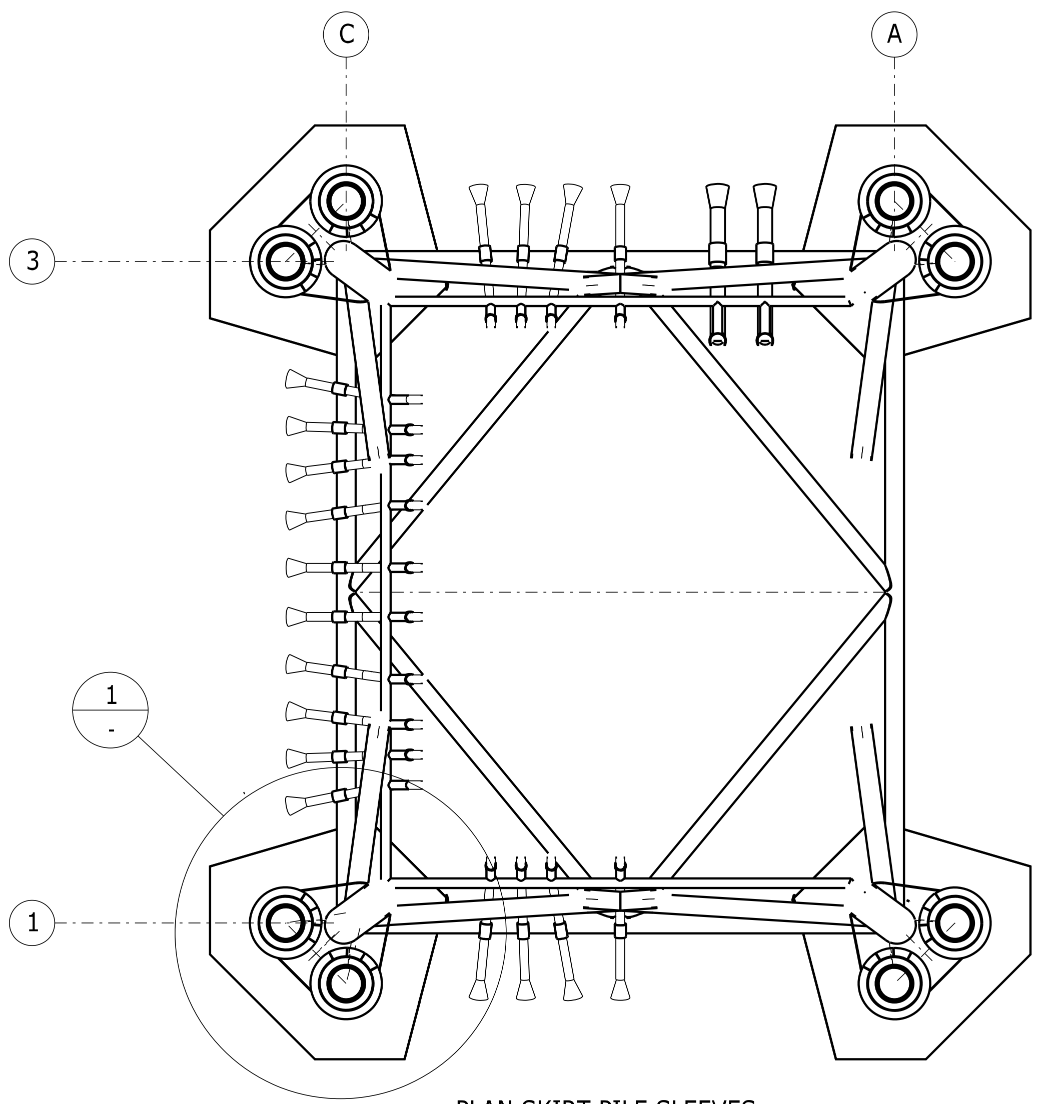
TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

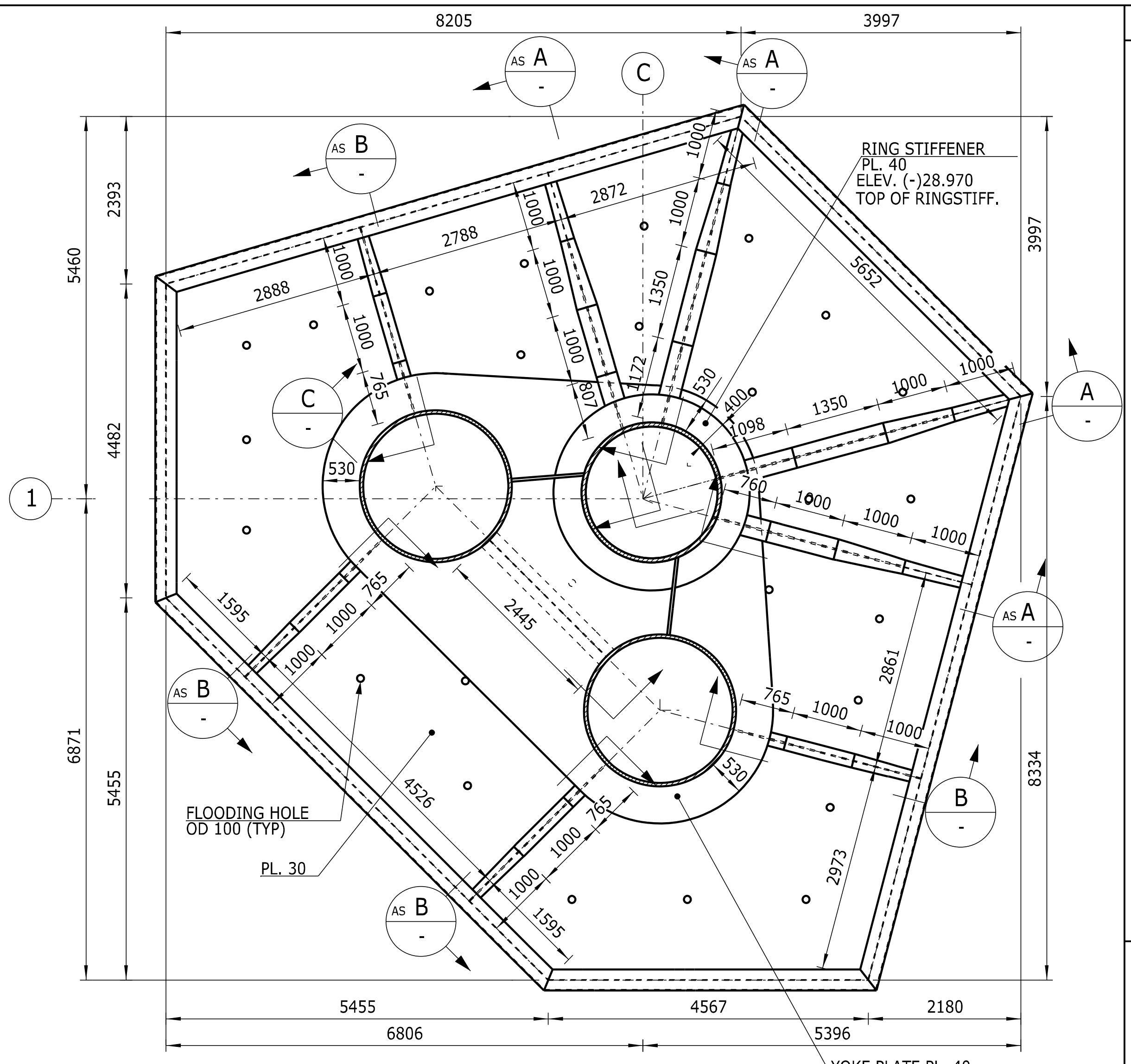
Title
OFFSHORE GRID NL
JACKET STRUCTURE
SKIRT PILE SLEEVES

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-10	0

FILENAME: X:\GlobalProjects\2015\1100015665\N-Structural\Substructure\Basic_design_phase\Deliverables\Drawings\ROGE-N-XG-000007-10



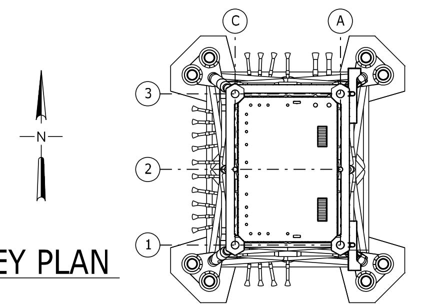
PLAN SKIRT PILE SLEEVES
SCALE 1:200



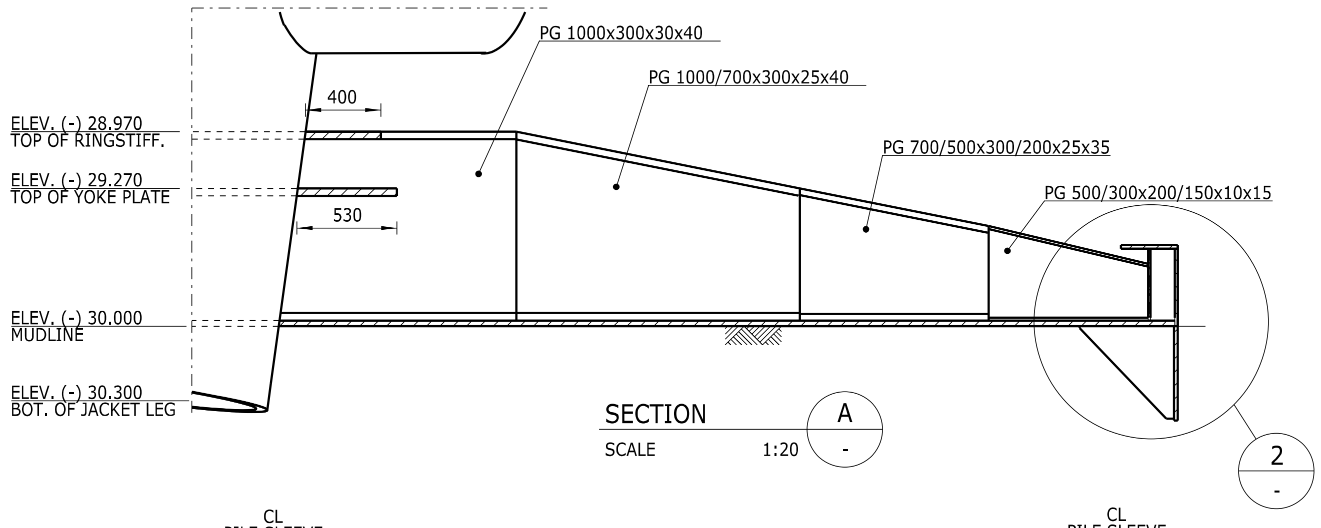
DETAIL (TYP.) 1
SCALE 1:50 -

NOTES

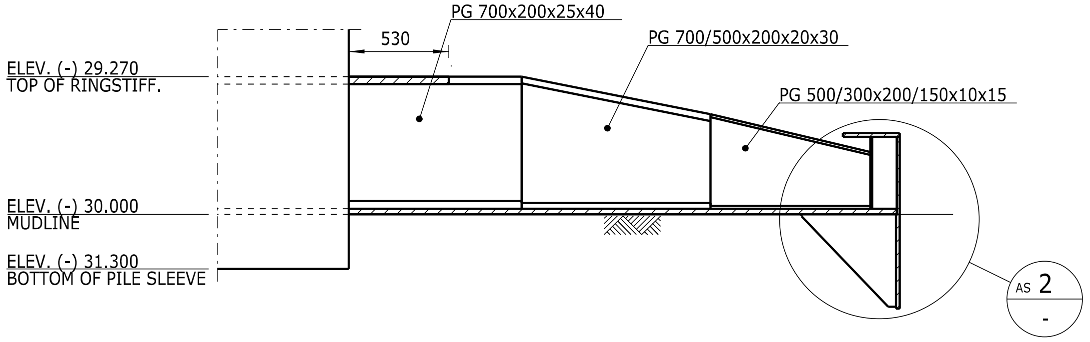
1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O.
3. WELDS TO BE INSPECTION CATEGORY II ACC. TO DNV-OS-C101 U.N.O.
4. WELDS TO BE DOUBLE SIDED FULL PENETRATION WELD U.N.O.
5. ALL STEEL TO BE ST1 U.N.O.



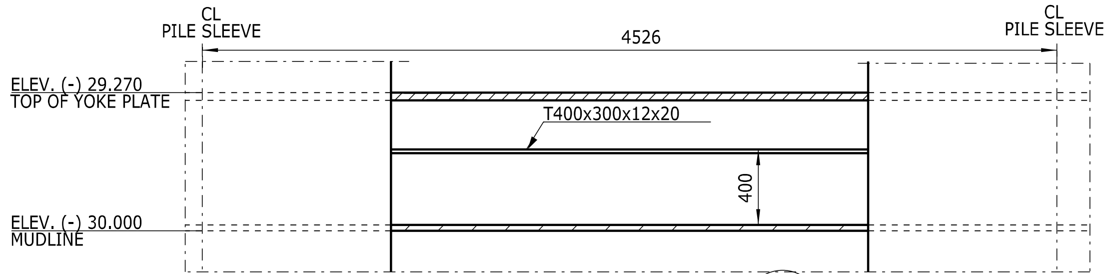
KEY PLAN



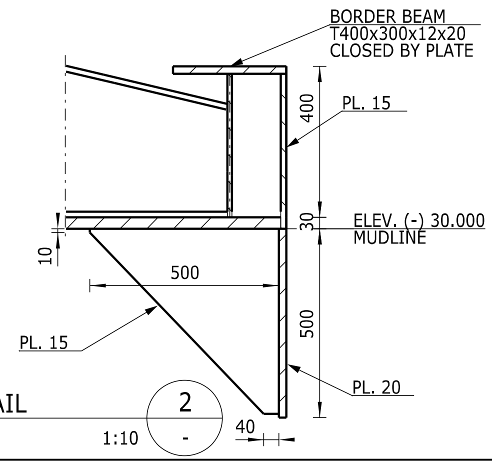
SECTION A
SCALE 1:20 -



SECTION B
SCALE 1:20 -



SECTION C
SCALE 1:20 -



DETAIL 2
SCALE 1:10 -

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

Drawing no. | Reference dwgs.

Job no. 1100015665

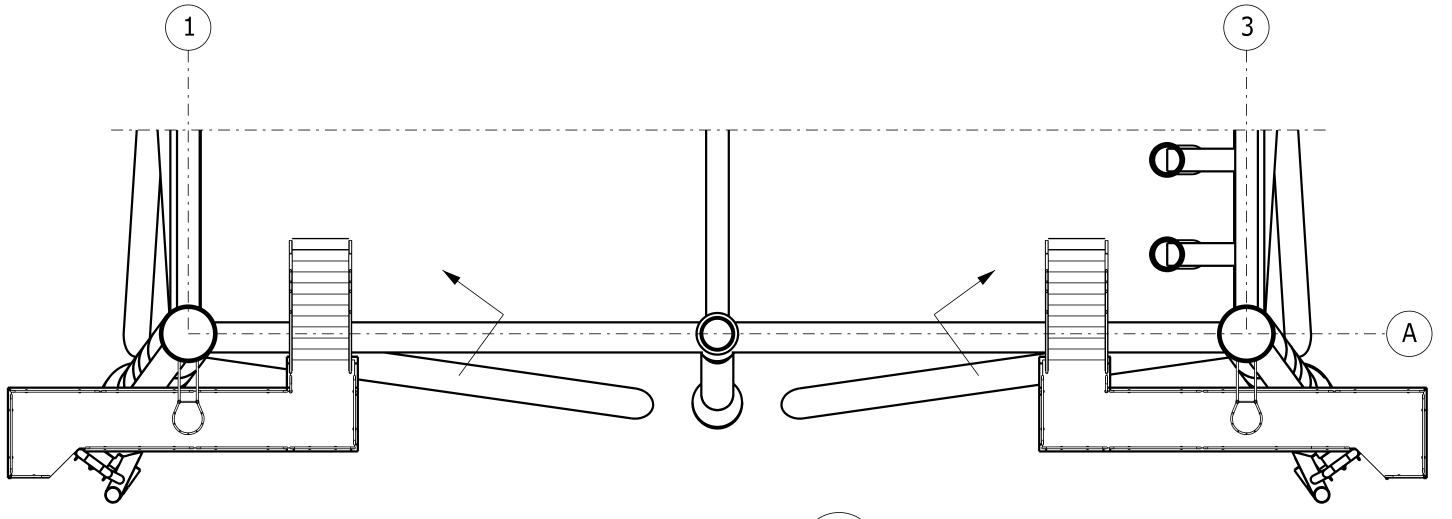
TenneT
Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

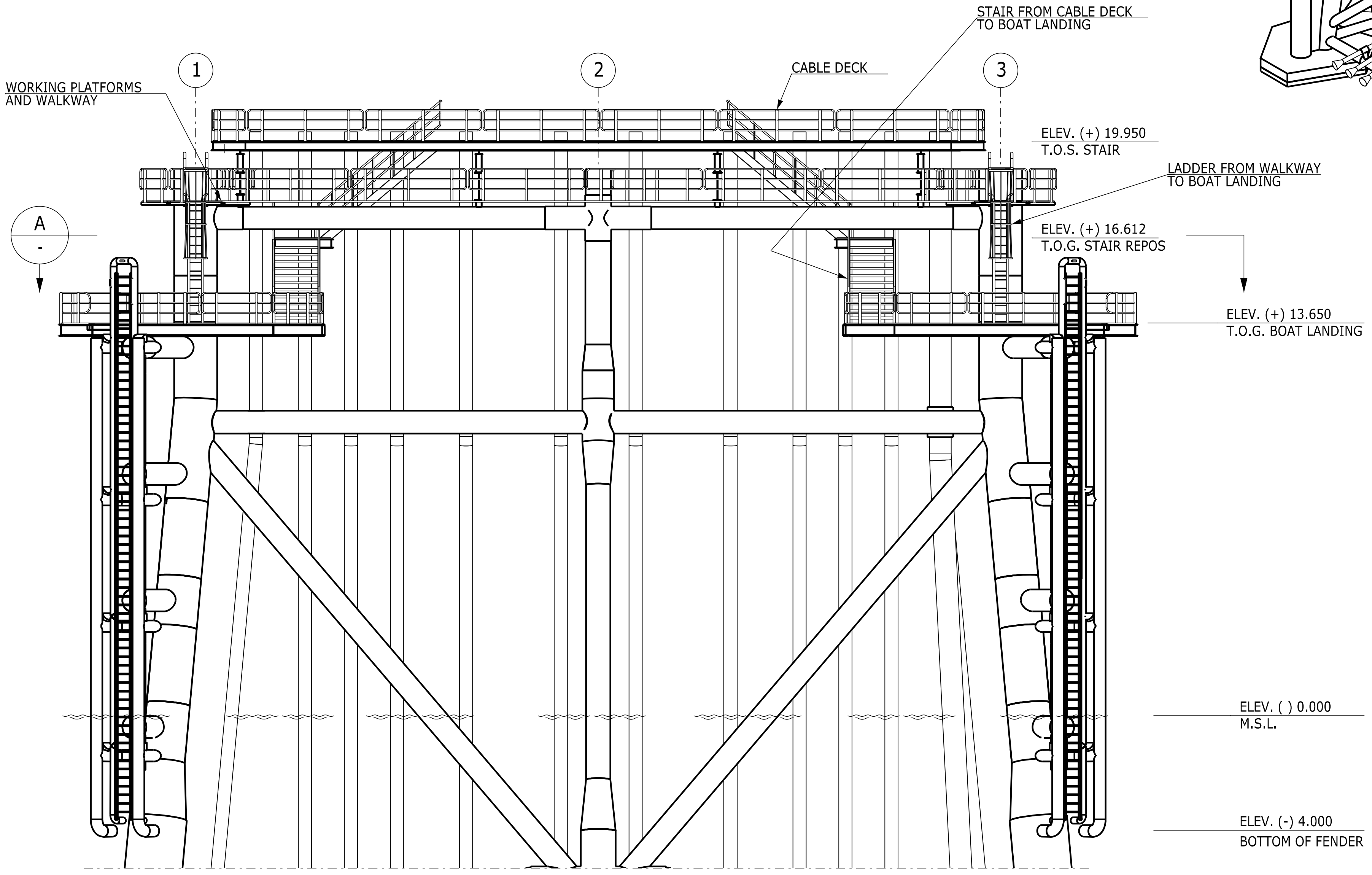
Title
OFFSHORE GRID NL
JACKET STRUCTURE
MUDMATS

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-11	0

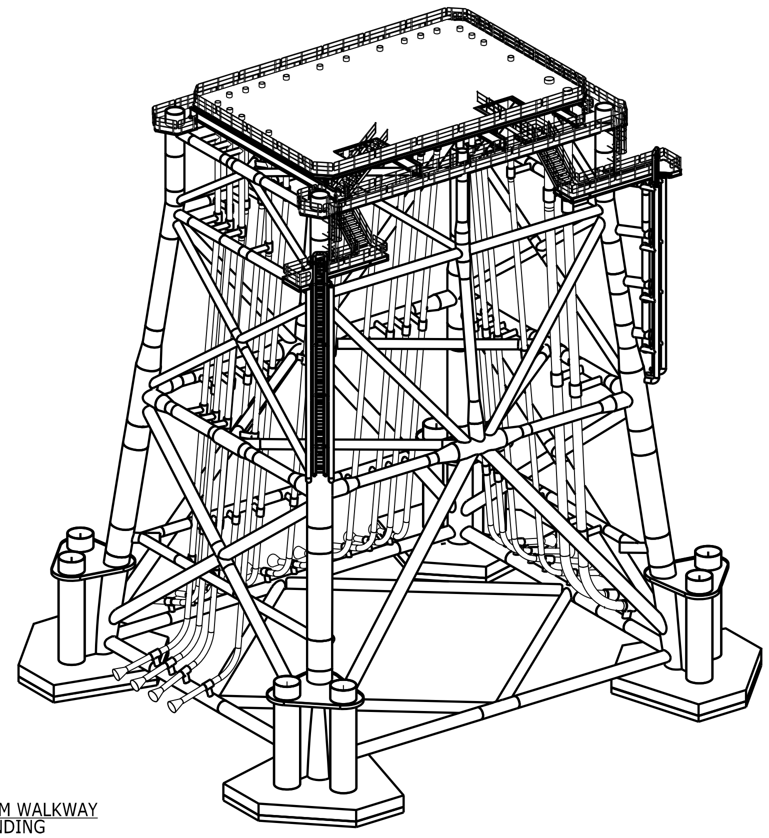
FILENAME: X:\GlobalProjects\2015\1100015665\N-Structural\Substructure\Basic_design_phase\Deliverables\Drawings\ROGE-N-XG-



SECTION A
SCALE 1:100



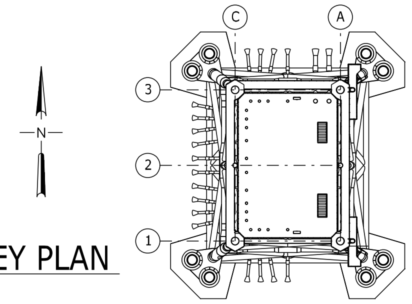
VIEW BOAT LANDINGS, ROW A
SCALE 1:100



ISO VIEW BOAT LANDINGS
SCALE NONE

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/BBR	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
BOAT LANDING AND STAIRS
PLAN AND ELEVATION

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-12	0

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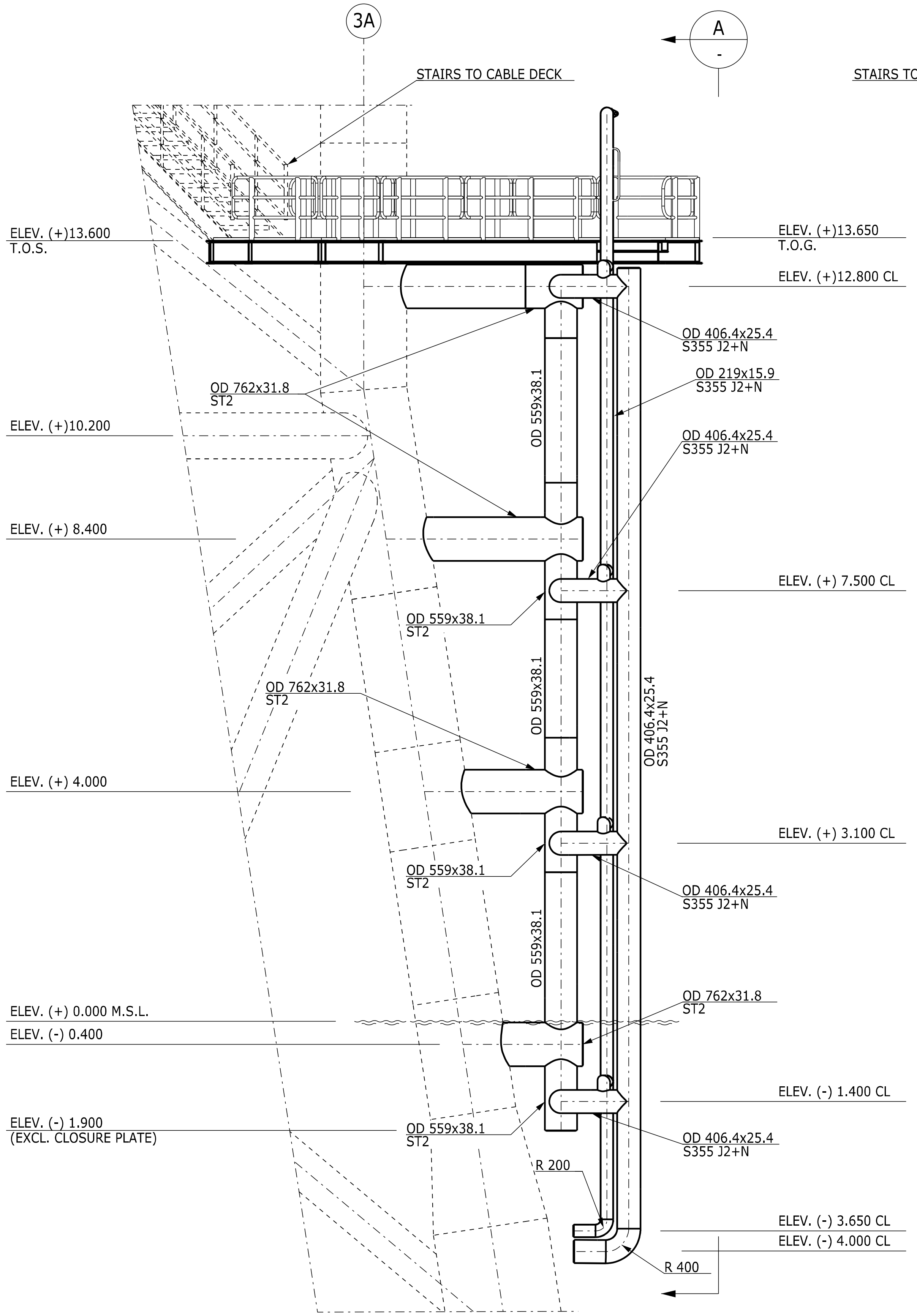
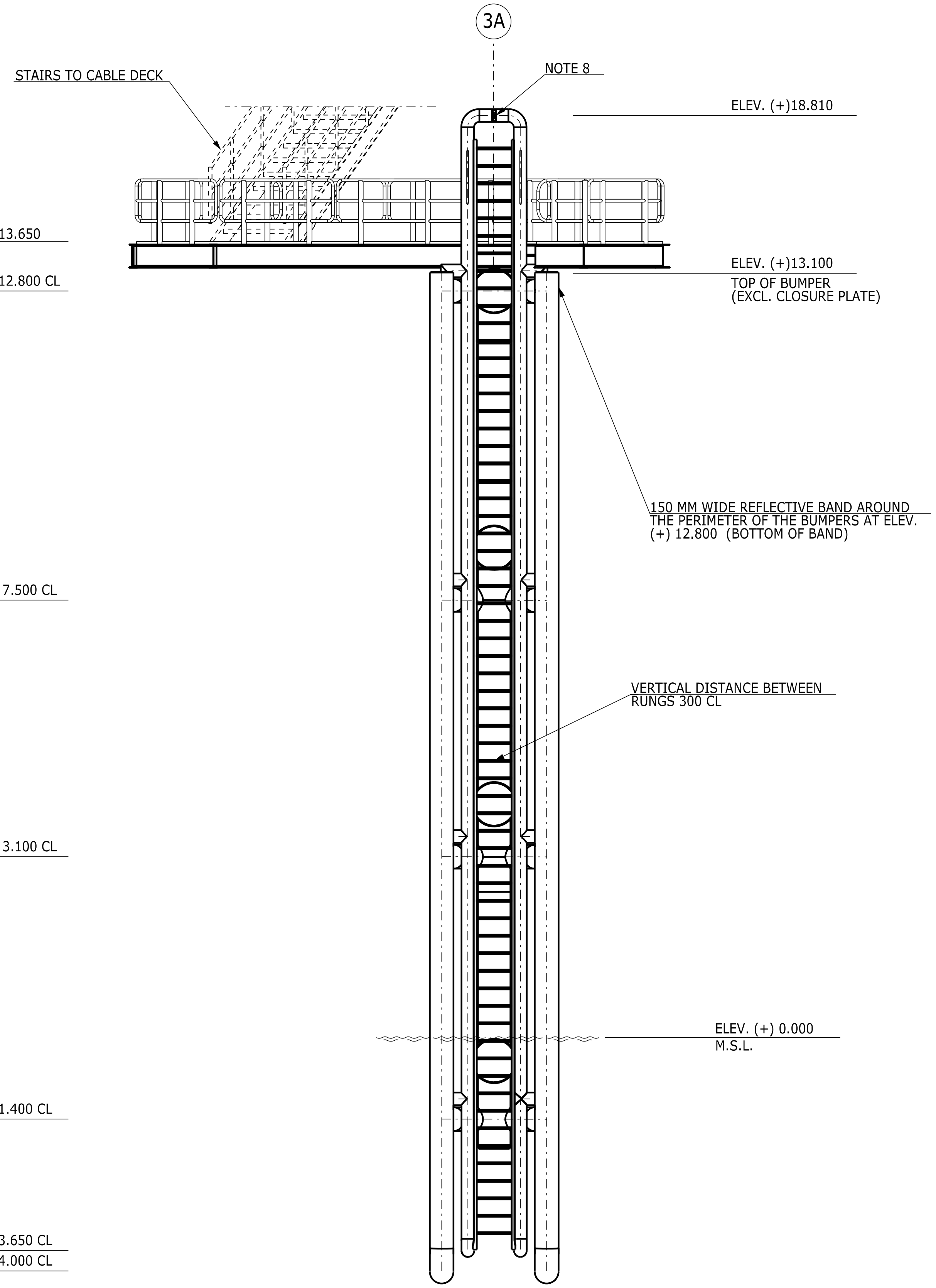


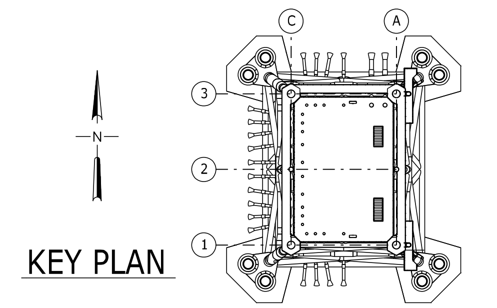
SECTION A
SCALE 1:50 -12



SECTION A
SCALE 1:50 -

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL ELEVATIONS ARE WITH RESPECT TO M.S.L.
3. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C401 SECONDARY STRUCTURE CATEGORY WITH MATERIAL CERTIFICATE 3.1 ACC. TO EN 10204 U.N.O.
4. ALL STEEL TO BE ST1 U.N.O.
5. FOR TUBULAR WELDING DETAILS SEE DRWG. ROGE-N-GN-000012-02 .
6. ALL WELDS TO BE DOUBLE SIDED FULL PENETRATION WELDS FOR OD>508 MM. SINGLE SIDED CIRCUMFERENTIAL CLOSURE WELDS ACCEPTED.
7. WELDS TO BE INSPECTION CATEGORY III ACC. TO DNV OS-C101 U.N.O.
8. LATCHWAYS MANSAFE SEALED SRL (SELF RETRACTABLE LIFELINE) TO BE INSTALLED.
9. WELDS OF SECONDARY STEEL TO PRIMARY STEEL TO BE INSPECTION CATEGORY II ACC. TO DNV-OS-C101.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/BBR	STC	MXH	ISSUED FOR COMMENTS

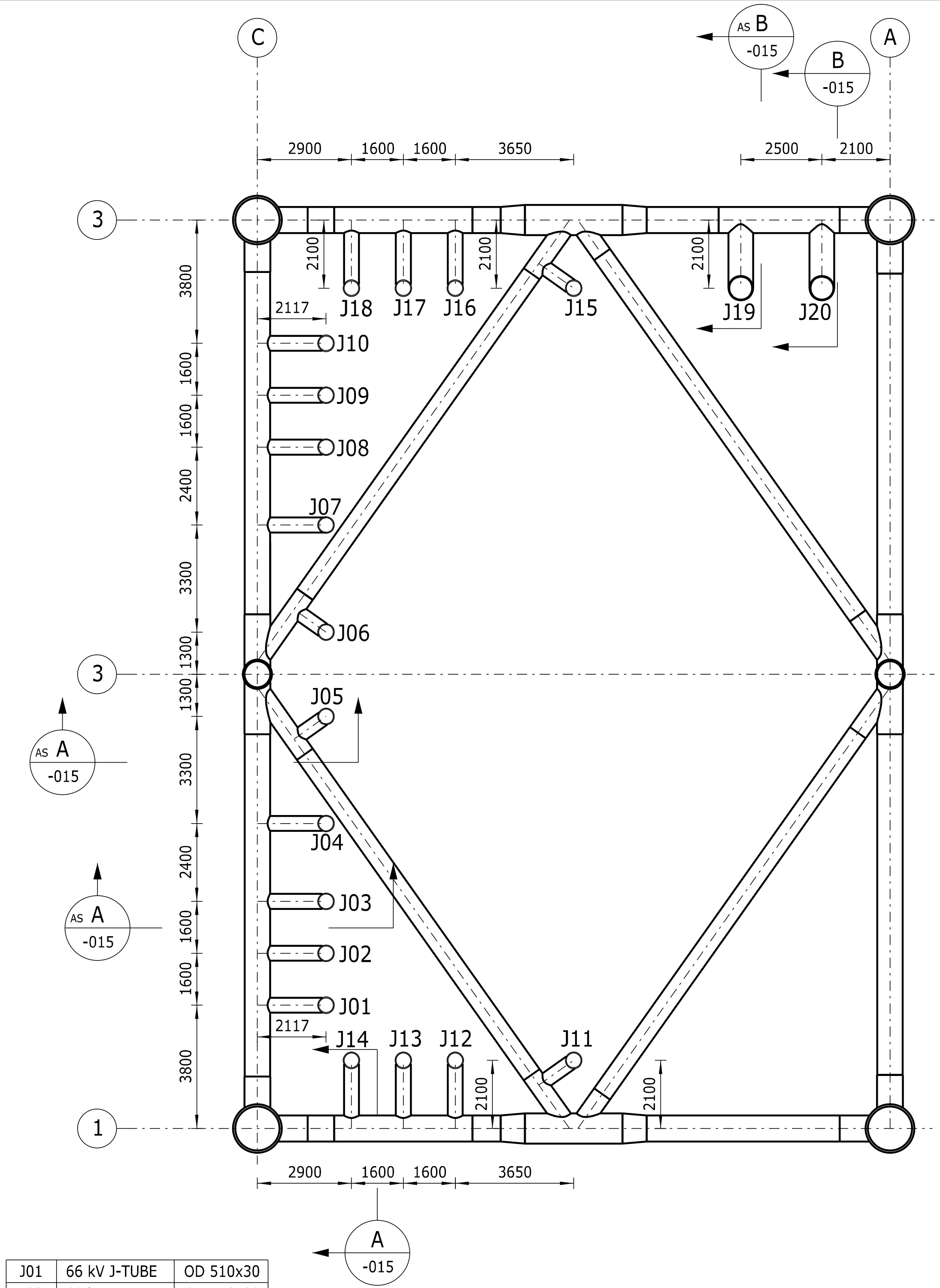
Job no. 1100015665

TenneT
Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

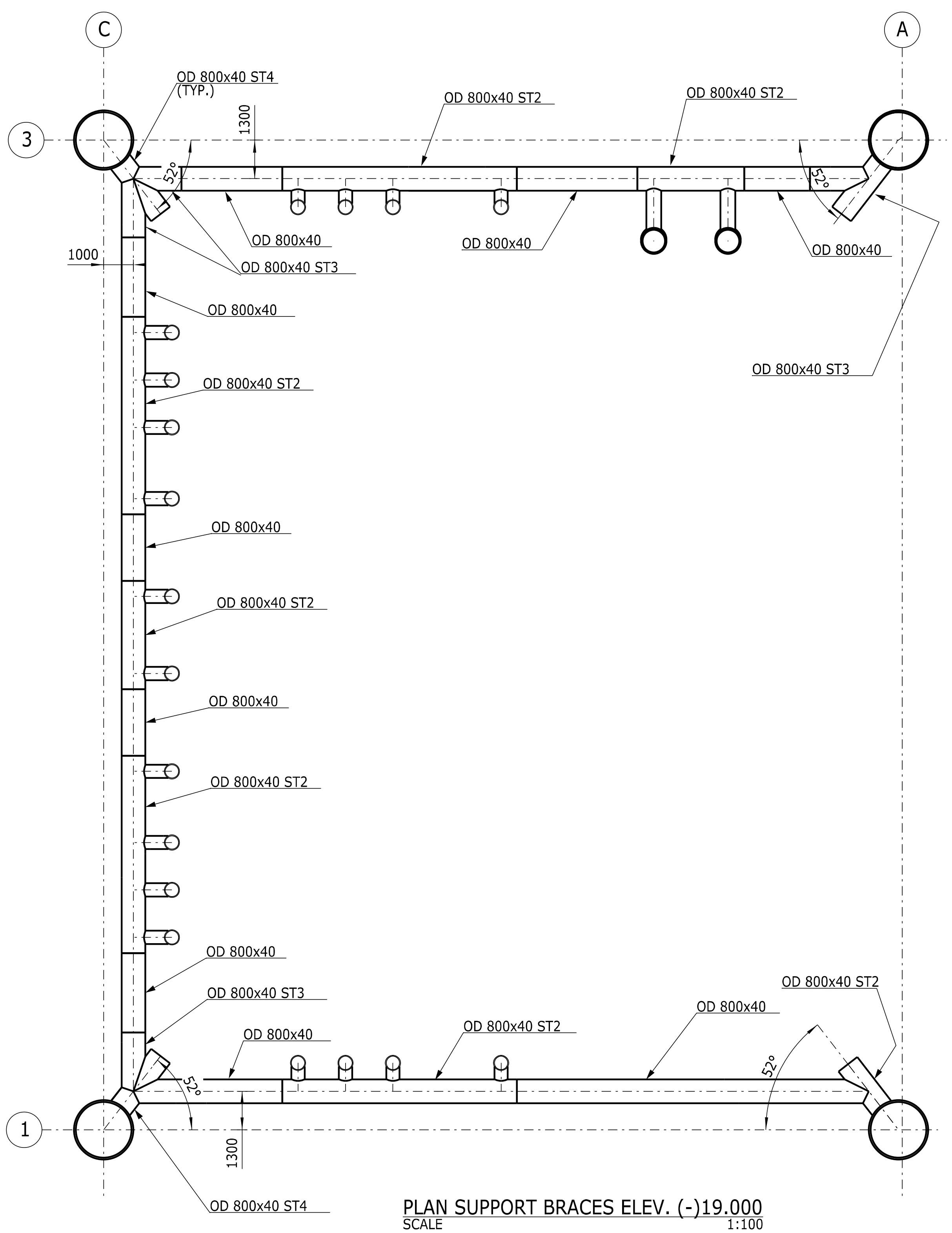
Title
OFFSHORE GRID NL
JACKET STRUCTURE
BOAT LANDING
SECTIONS AND DETAILS

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-X-000007-13	0



J01	66 kV J-TUBE	OD 510x30
J02	66 kV J-TUBE	OD 510x30
J03	66 kV J-TUBE	OD 510x30
J04	66 kV J-TUBE	OD 510x30
J05	66 kV J-TUBE	OD 510x30
J06	66 kV J-TUBE	OD 510x30
J07	66 kV J-TUBE	OD 510x30
J08	66 kV J-TUBE	OD 510x30
J09	66 kV J-TUBE	OD 510x30
J10	66 kV J-TUBE	OD 510x30
J11	66 kV J-TUBE	OD 510x30
J12	66 kV J-TUBE	OD 510x30
J13	66 kV J-TUBE	OD 510x30
J14	66 kV J-TUBE	OD 510x30
J15	66 kV J-TUBE	OD 510x30
J16	66 kV J-TUBE	OD 510x30
J17	66 kV J-TUBE	OD 510x30
J18	66 kV J-TUBE	OD 510x30
J19	220 kV J-TUBE	OD 760x30
J20	220 kV J-TUBE	OD 760x30

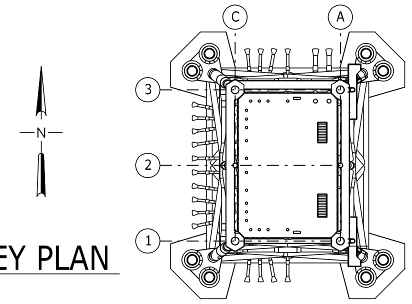
PLAN TOP OF JACKET, J-TUBE NUMBERING
SCALE 1:100



PLAN SUPPORT BRACES ELEV. (-)19.000
SCALE 1:100

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O. TUBULAR JOINTS TO BE SPECIAL STRUCTURAL CATEGORY.
3. WELDS TO BE INSPECTION CATEGORY I OR II ACC. TO DNV-OS-C101 U.N.O
4. WELDS TO BE DOUBLE SIDED FULL PENETRATION WELD U.N.O. GIRTH WELDS TO BE SINGLE SIDED FULL PENETRATION WELD U.N.O.
5. ALL STEEL TO BE ST1 U.N.O.



KEY PLAN

Drawing no. | Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

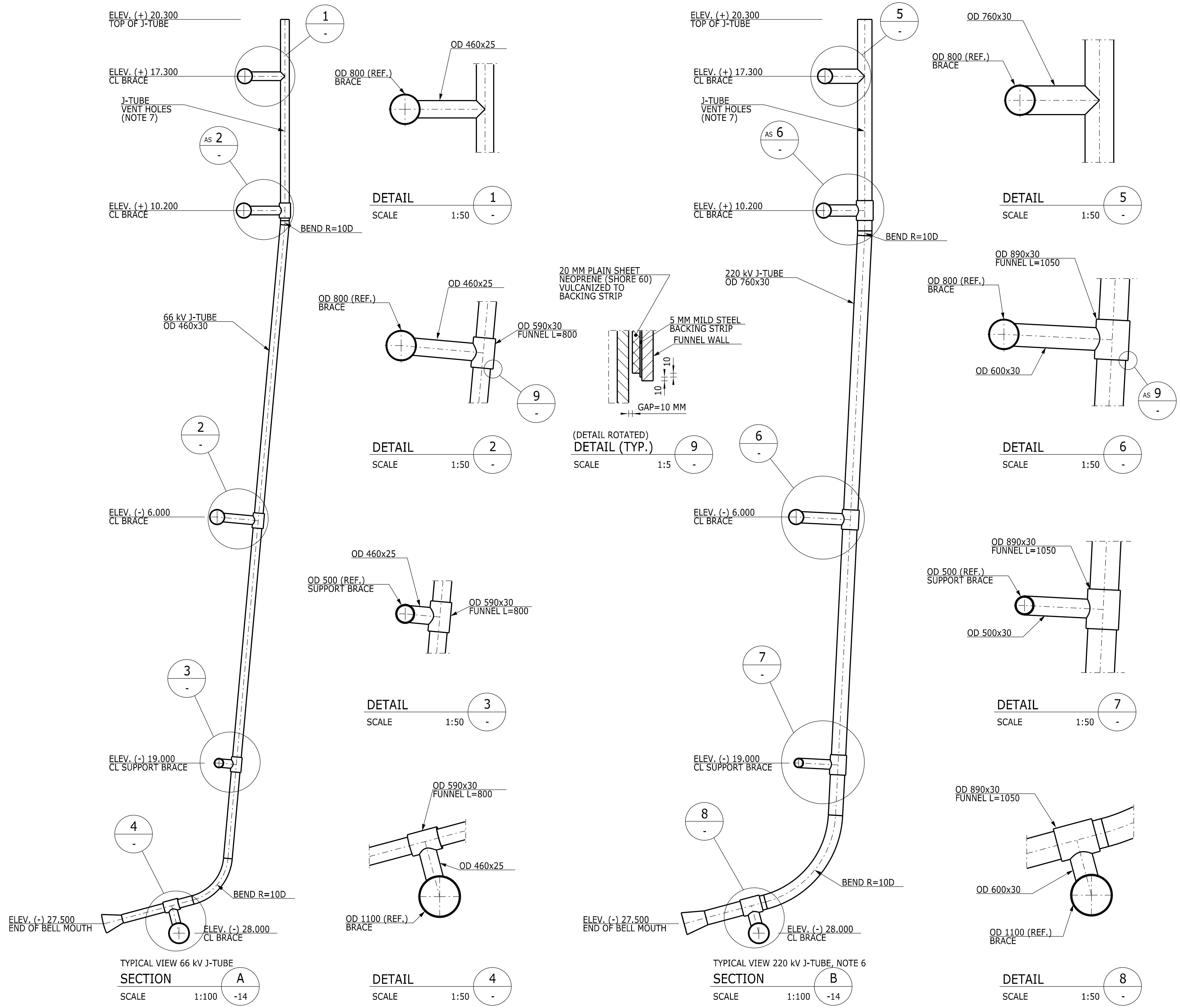
Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

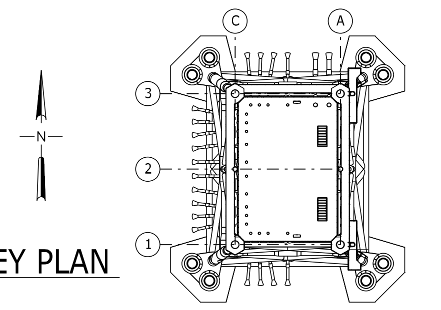
Title
OFFSHORE GRID NL
JACKET STRUCTURE
J-TUBES
PLANS AND NUMBERING

Scale NOTED | Size A1 | Drawing no. ROGE-N-XG-000007-14 | Rev. 0



NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O. TUBULAR JOINTS TO BE SPECIAL STRUCTURAL CATEGORY.
3. WELDS TO BE INSPECTION CATEGORY I OR II ACC. TO DNV-OS-C101 U.N.O
4. CIRCUMFERENTIAL WELDS TO BE FULL PENETRATION DOUBLE SIDED ON MAIN LEGS U.N.O.
5. WELD IN CONICAL TRANSITIONS AND NODAL JOINTS TO BE FULL PENETRATION DOUBLE SIDED U.N.O. SINGLE SIDED CLOSURE WELD AT CONE NARROW END.
6. ALL STEEL TO BE ST1 U.N.O.
7. VENT HOLES TO BE SIZED BASED ON CABLE SPECIFICATIONS AND HEAT DISSIPATION ESTIMATES.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

TenneT Taking power further

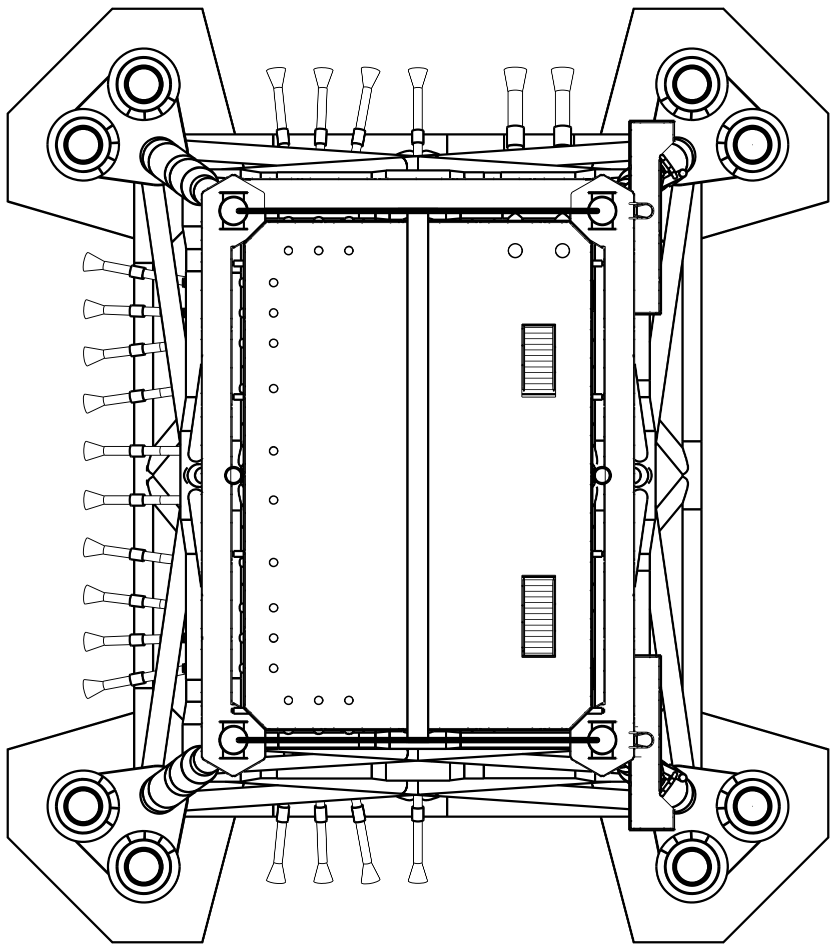
STANDARD 700MW AC OFFSHORE SUBSTATION

Title

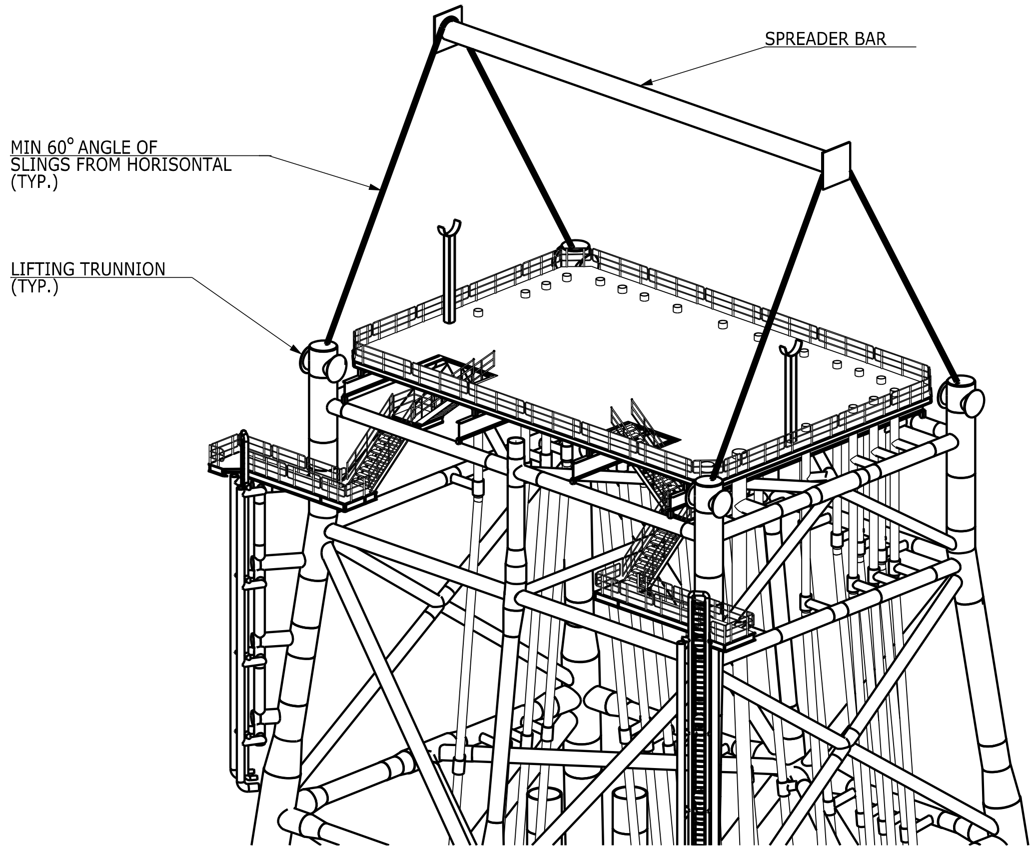
OFFSHORE GRID NL

JACKET STRUCTURE
J-TUBES
TYPICAL MAKE-UP AND SECTIONS

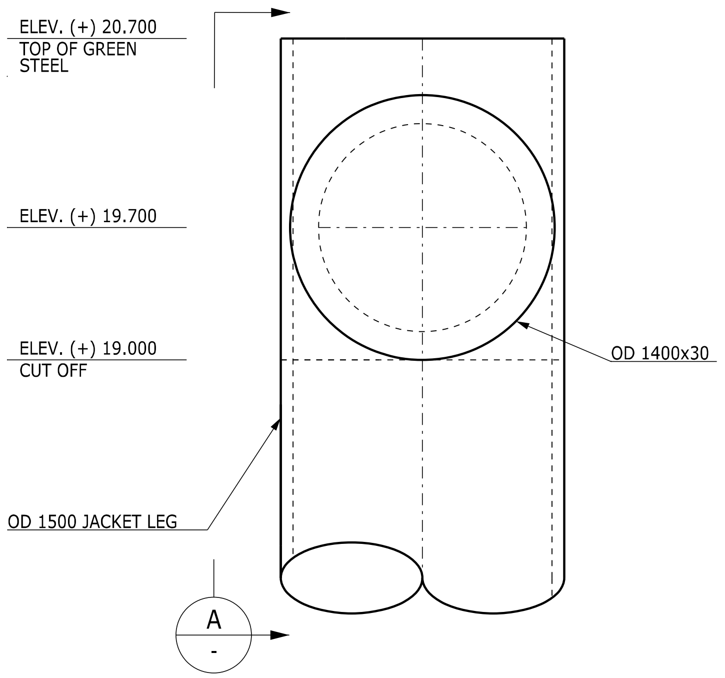
Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-15	0



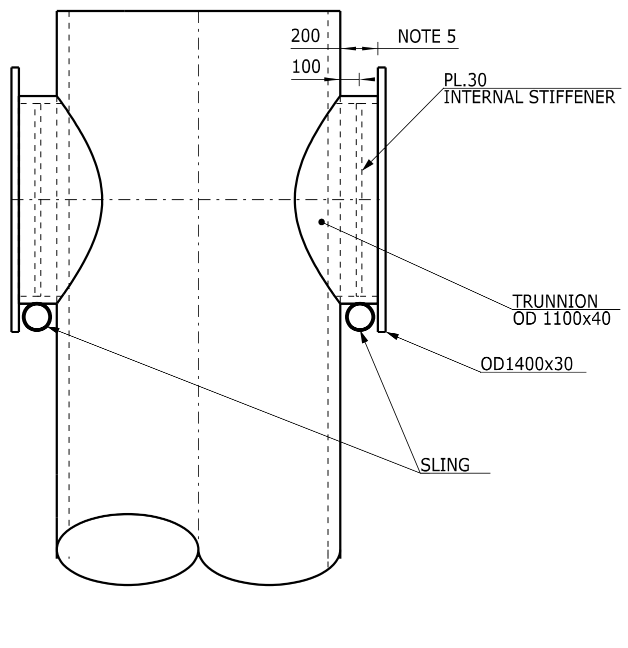
TOP VIEW, LIFTING ARRANGEMENT
SCALE 1:200



ISO VIEW, LIFTING ARRANGEMENT
SCALE 1:200



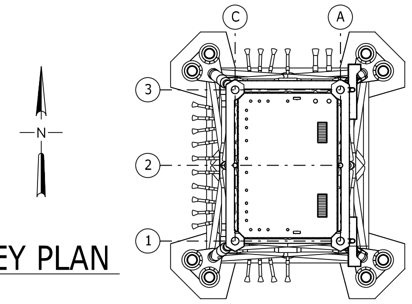
LIFTING TRUNNION EXAMPLE FOR INFO ONLY
SCALE 1:20



SECTION A -
SCALE 1:20

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEEL TO BE ST2 U.N.O.
3. ALL STEEL WORK ON THIS DRAWING IS IN ACCORDANCE WITH DNV-OS-C401 SPECIAL STRUCTURE CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O.
4. AFTER INSTALLATION TRUNNION AND GREEN STEEL TO BE CUT-OFF, GROUND FLUSH AND TOP OF LEG BEVELLED BEFORE MATING OF TOPSIDES.
5. SPACING TO BE CONFIRMED BY INSTALLATION CONTRACTOR IN ACCORDANCE WITH SLING SIZE.
6. IN GENERAL ALL LIFTING AND INSTALLATION ARRANGEMENTS ARE SUBJECT TO APPROVAL BY THE RESPECTIVE TRANSPORTATION AND INSTALLATION CONTRACTORS AS WELL AS THE MARINE WARRANTY SURVEYOR PRIOR TO FABRICATION.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/BBR	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

TenneT
Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
LIFTING ARRANGEMENT, LIFT POINTS

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-16	0

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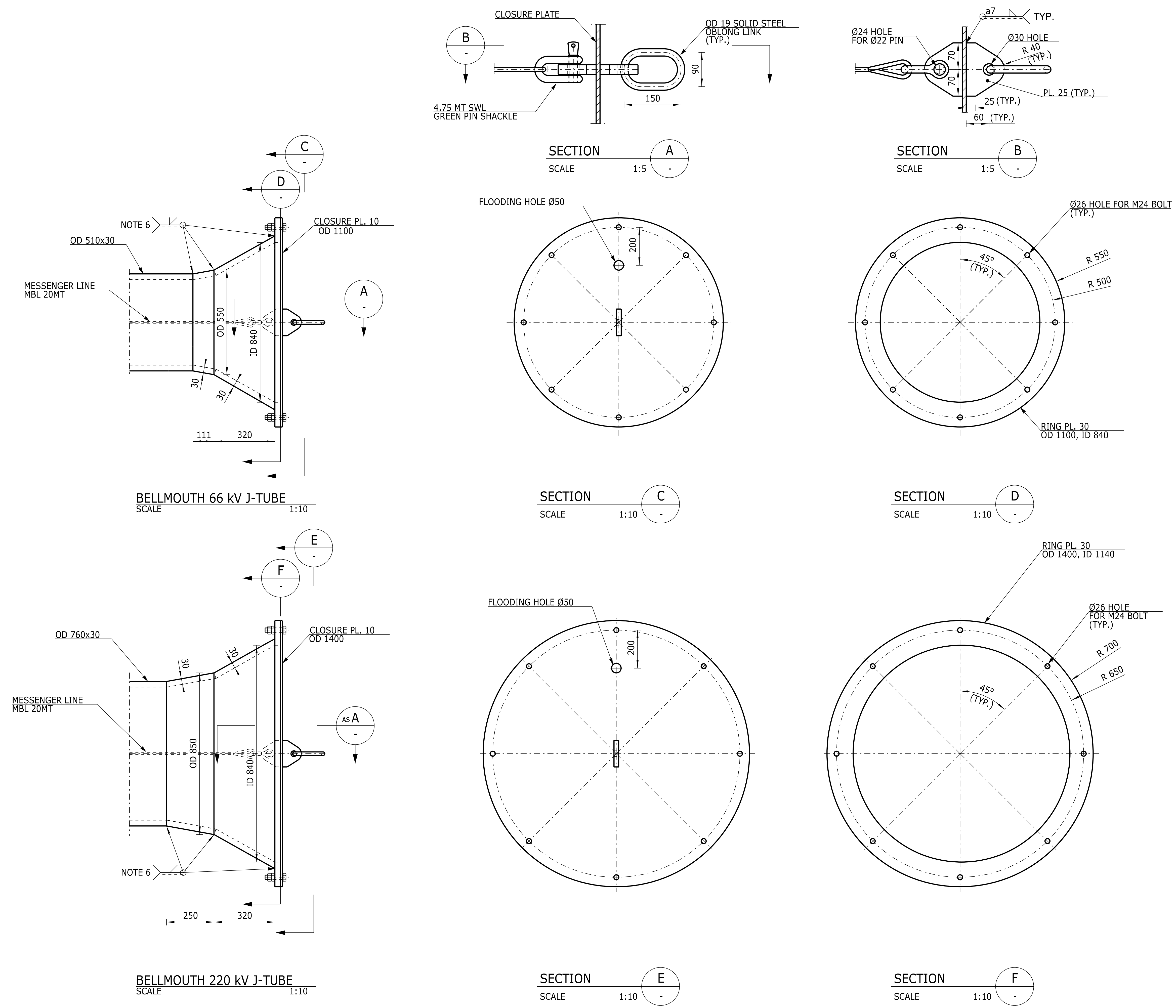
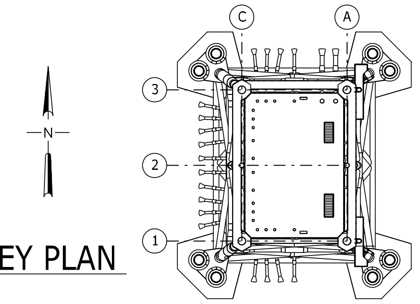


NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O.
3. WELDS TO BE INSPECTION CATEGORY II ACC. TO DNV-OS-C101 U.N.O.
4. WELD IN CONICAL TRANSITIONS TO BE FULL PENETRATION DOUBLE SIDED U.N.O.
5. ALL STEEL TO BE ST1 U.N.O.
6. WELDS INSIDE BELLMOUTH TO BE GROUND SMOOTH.
7. LAYOUT OF BELLMOUTH, CLOSURE PLATE AND MESSENGER LINE ATTACHMENT IS SUBJECT TO ACCEPTANCE BY CABLE INSTALLATION CONTRACTOR.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	18-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

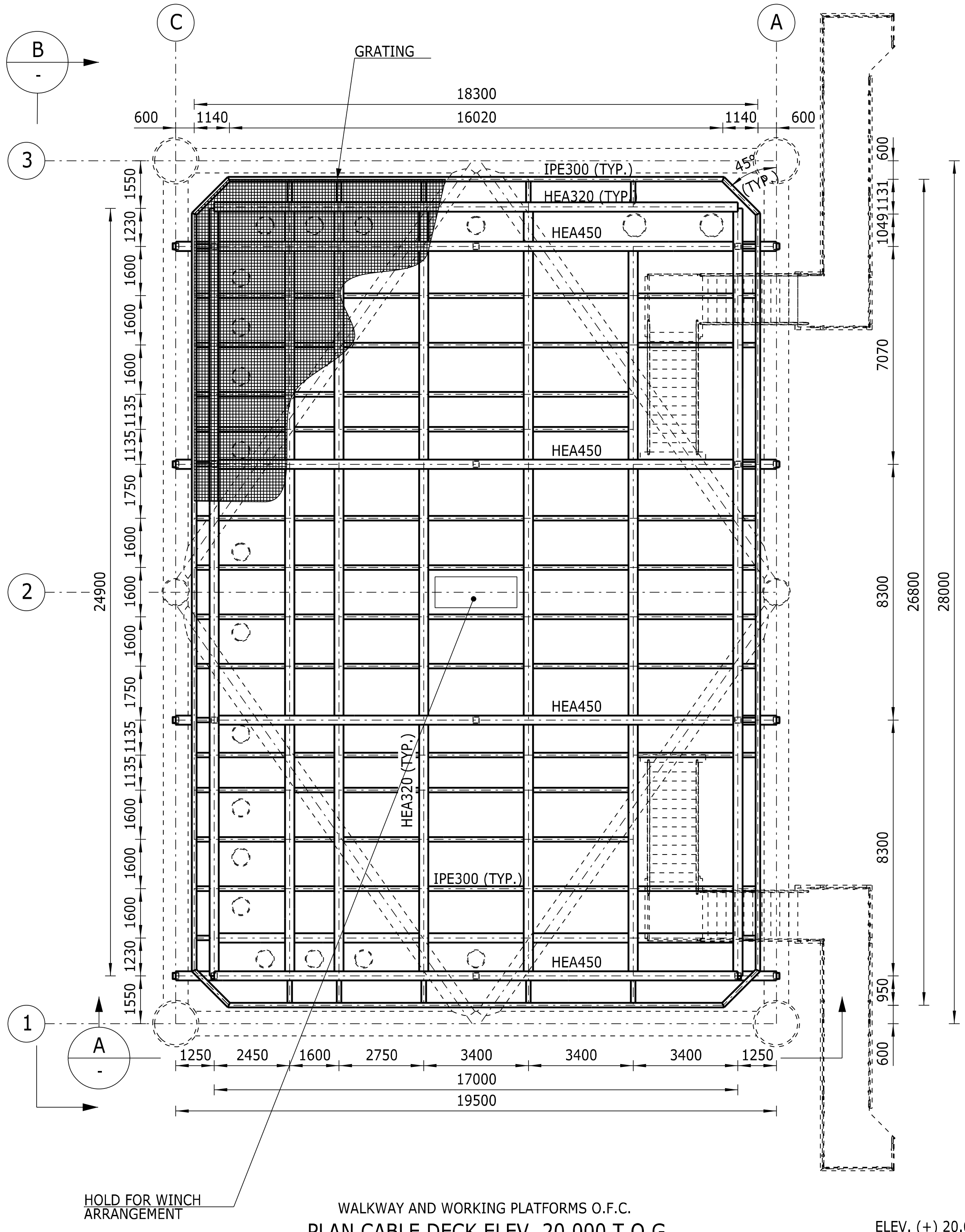
TenneT — Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title: OFFSHORE GRID NL

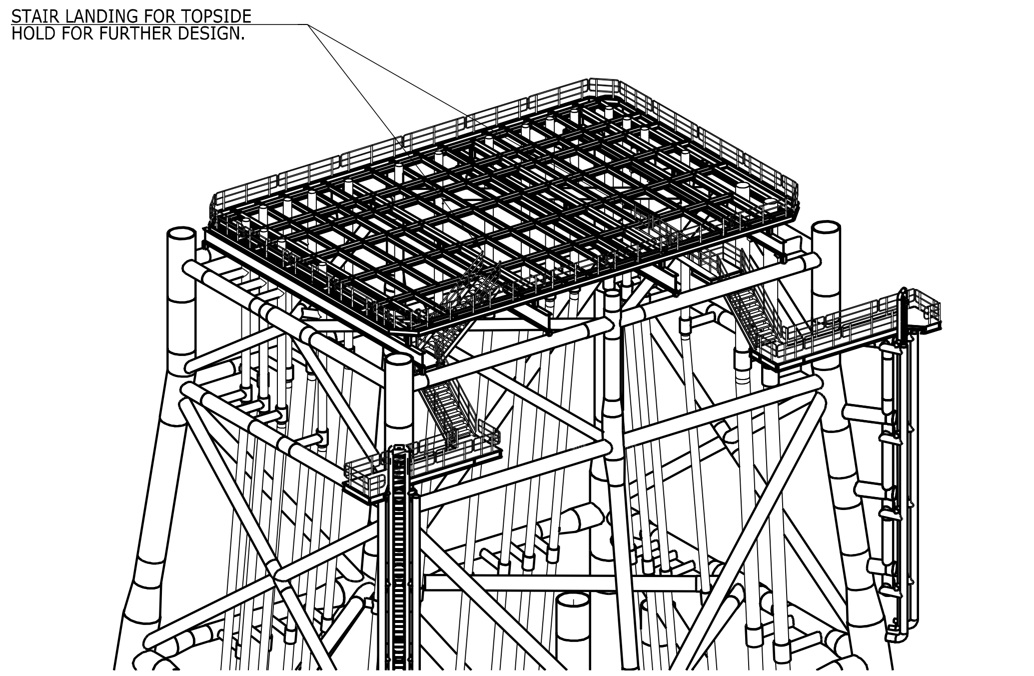
JACKET STRUCTURE
BELLMOUTH FOR 66 KV J-TUBE AND 220 KV J-TUBE

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-17	0



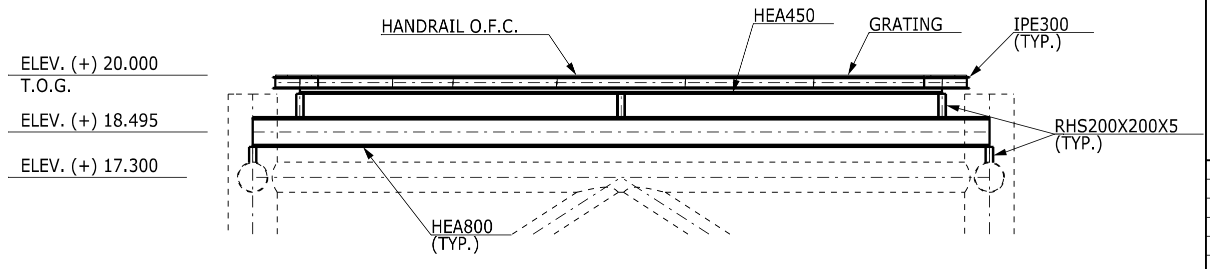
WALKWAY AND WORKING PLATFORMS O.F.C.

PLAN CABLE DECK ELEV. 20.000 T.O.G.
SCALE 1:100

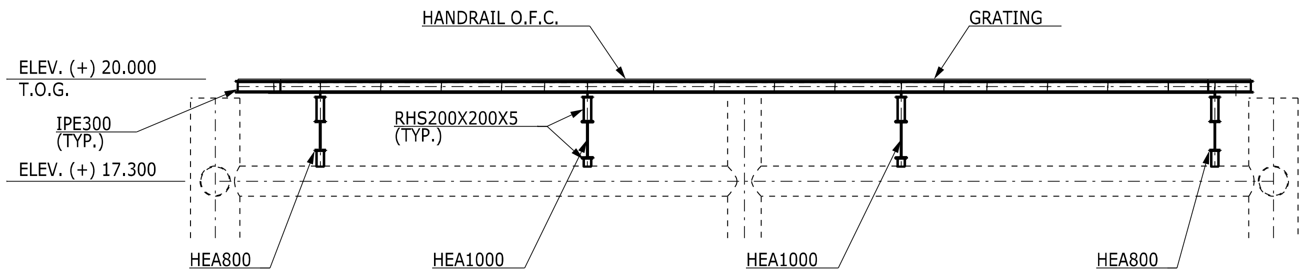


GRATING O.F.C.

ISO VIEW CABLE DECK
SCALE NONE



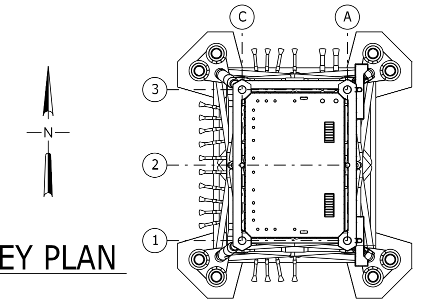
SECTION A -
SCALE 1:50



SECTION B -
SCALE 1:50

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O.
3. WELDS TO BE INSPECTION CATEGORY II ACC. TO DNV-OS-C101 U.N.O.
4. WELDS TO BE DOUBLE SIDED FULL PENETRATION WELD U.N.O.
5. ALL STEEL TO BE ST1 U.N.O.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/BBR	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

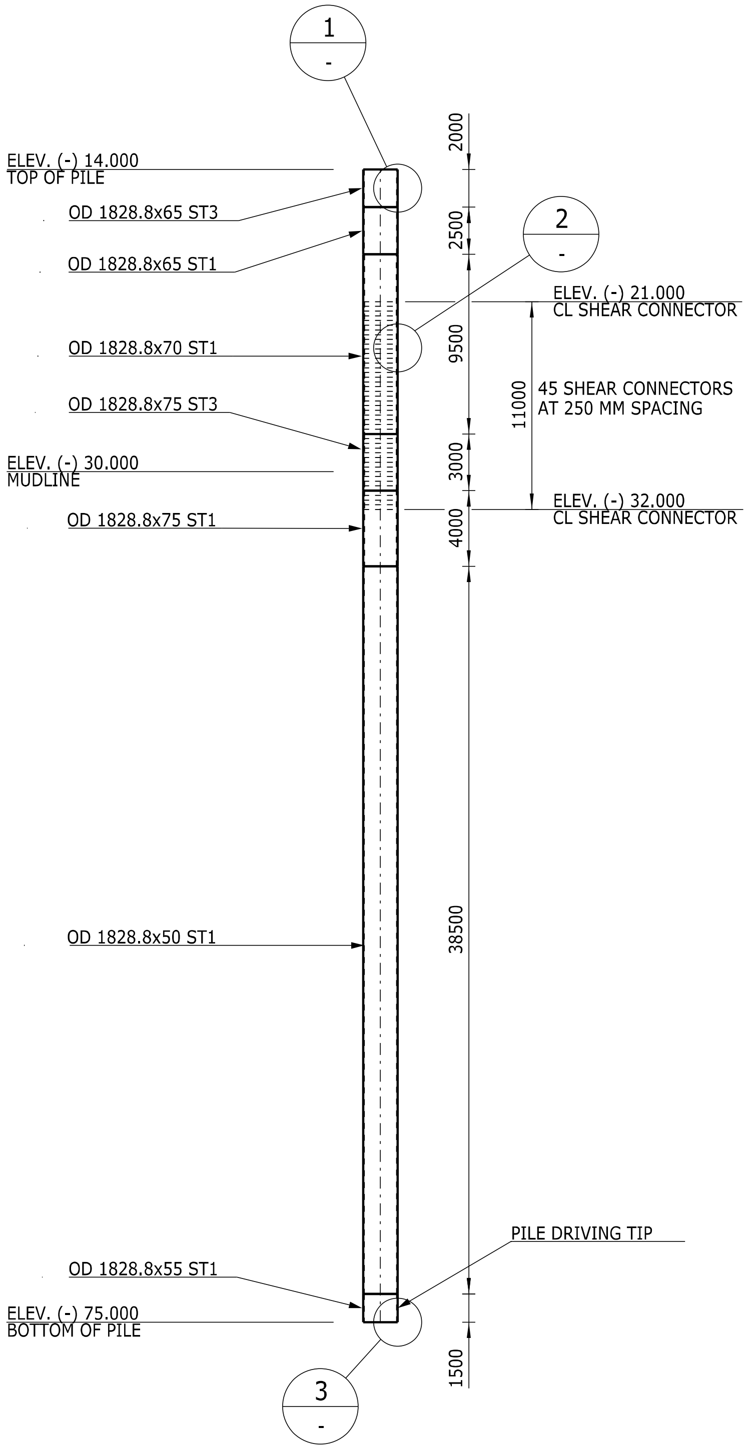
TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

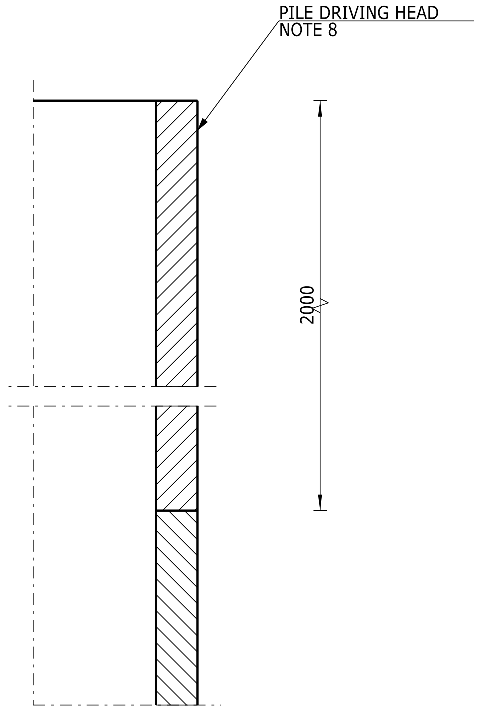
Title
OFFSHORE GRID NL
JACKET STRUCTURE
CABLE DECK, PLAN AND SECTIONS

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-18	0

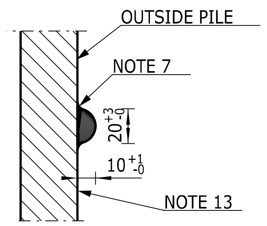
FILENAME: X:\GlobalProjects\2015\1100015665\N-Structural\Substructure\Basic_design phase\Deliverables\Drawings\ROGE-N-XG-000007-18



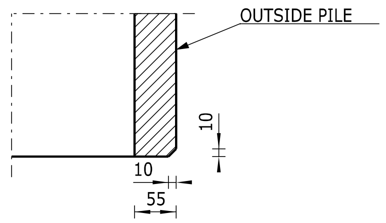
TYPICAL PILE MAKE-UP (8 NOS REQ'D)
SCALE 1:200



DETAIL 1
SCALE 1:5



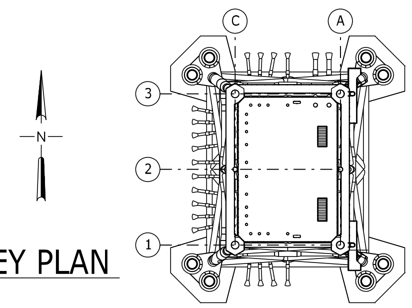
DETAIL 2
SCALE 1:2



DETAIL 3
SCALE 1:5

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O.
3. WELDS TO BE INSPECTION CATEGORY II ACC. TO DNV-OS-C101 U.N.O.
4. WELDS TO BE DOUBLE SIDED FULL PENETRATION WELD U.N.O.
5. ALL STEEL TO BE ST1 U.N.O.
6. SHEAR CONNECTORS TO BE LOCATED MIN. 150 MM FROM CIRCUMFERENTIAL BUTT WELDS.
7. SHEAR CONNECTORS TO BE WELDED WITH A SMOOTH TRANSITION TO BASE METAL.
8. DIMENSIONAL CONTROL REPORT AND AS BUILT DIM. FOR DRIVING HEAD TO BE SUBMITTED TO EMPLOYER AND INSTALLATION CONTRACTOR FOR APPROVAL ONE MONTH PRIOR TO SAIL AWAY.
9. THE HAMMER IHC S900 IS CONSIDERED IN PILE DESIGN OPERATED AT THE STROKE FROM ZERO TO TARGET PENETRATION.
10. FABRICATION TOLERANCES FOR MISALIGNED PIPE SURFACE ARE MAX. 4MM.
11. NO CIRCUMFERENTIAL WELDS, WALL THICKNESS VARIATIONS OR COATINGS ALLOWED ON INSIDE OF PILE DRIVING HEAD. ANY LONGITUDINAL WELDS TO BE GROUND FLUSH.
12. PILE TO BE INSTALLED WITHIN ±250MM FROM THEORETICAL PENETRATION RELATIVE TO PILE SLEEVE.
13. PILE FABRICATION REQUIRES TOLERANCE FOR PILE DIM. TO BE IN ACC. WITH NORSOK M-101, REF. SECTION E.5.3 FOR CIRCUMFERENCE AND OUT-OF-ROUNDNESS (OVALITY).
14. LEVELLING TOOL TO BE USED AFTER PILE DRIVING IN ORDER TO LEVEL JACKET. HYDRAULIC UNITS CONNECTING A LEVELLING TOOL AND PILE GUIDE WITH A GRIP LOAD.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

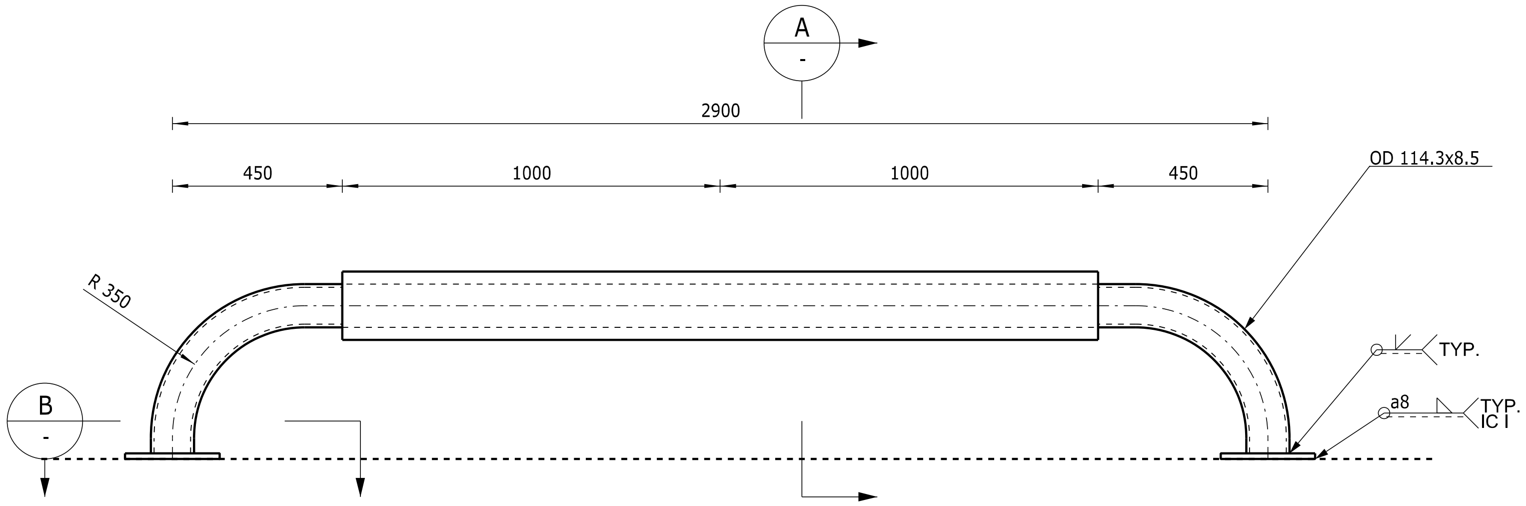
Job no. 1100015665

TenneT Taking power further

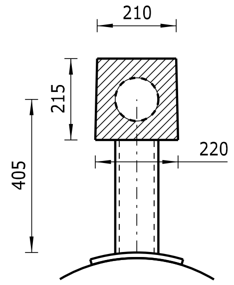
STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
PILE MAKE-UP

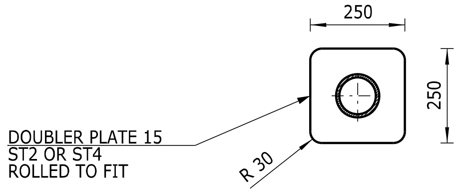
Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-19	0



EXTERNAL ANODE
SCALE 1:10



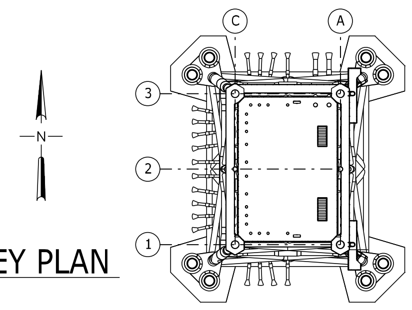
SECTION A -
SCALE 1:10



SECTION B -
SCALE 1:10

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO: ROGE-N-GN-00112-01, -02 AND -03.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	04-DEC-2015	FESA/BBR	STC	MXH	ISSUED FOR COMMENTS

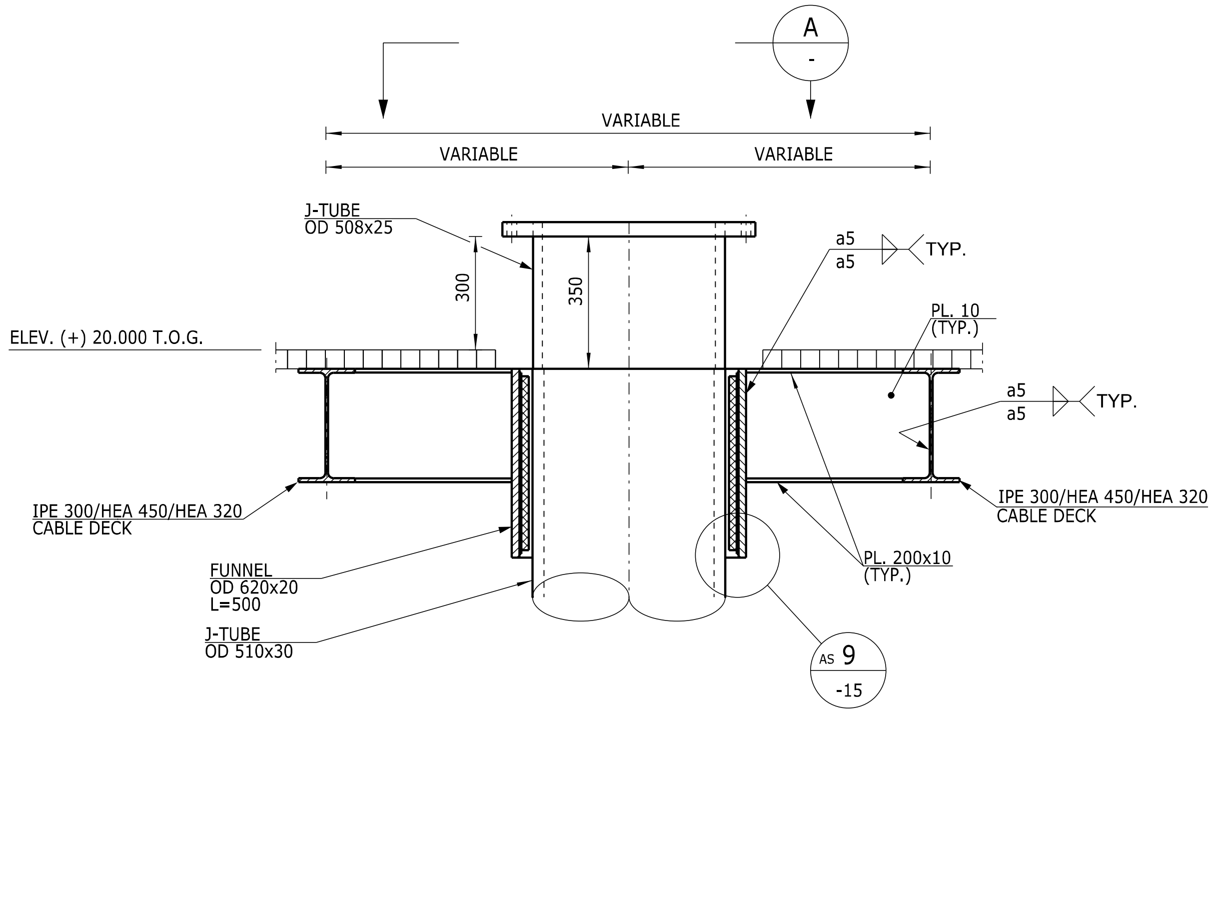
Job no. 1100015665

TenneT — Taking power further

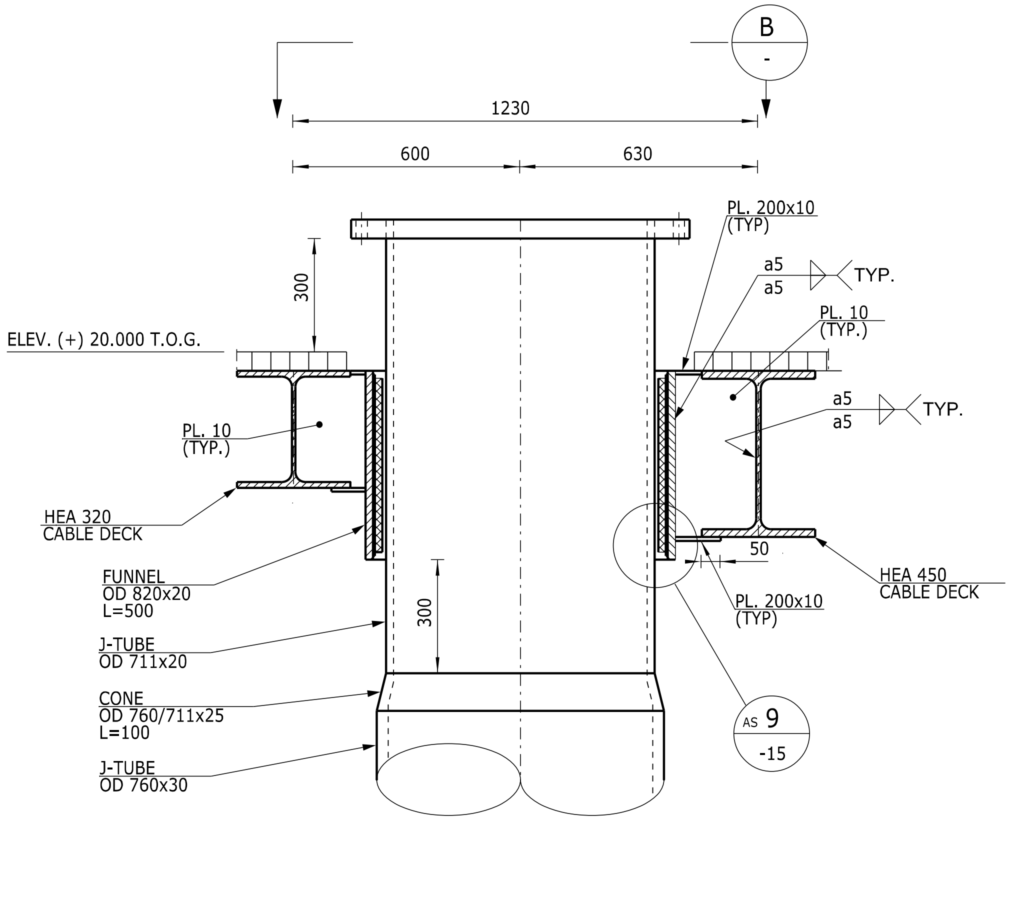
STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
JACKET STRUCTURE
ANODES

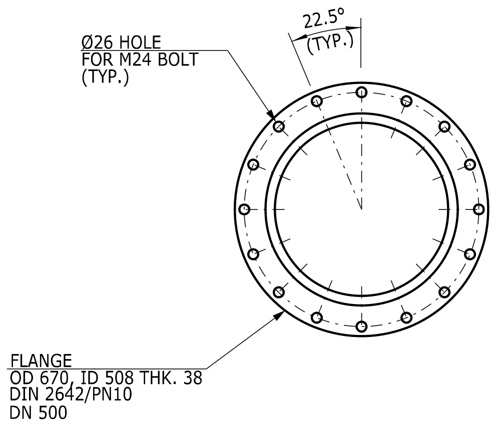
Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-20	0



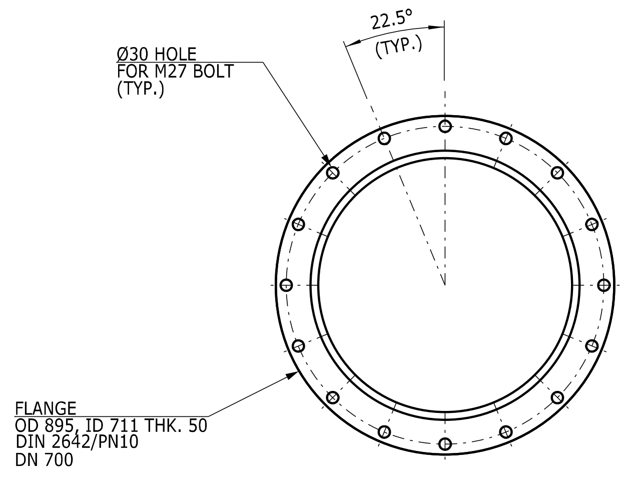
HANG OFF 66 kV J-TUBE (TYP.)
SCALE 1:10



HANG OFF 220 kV J-TUBE (TYP.)
SCALE 1:10



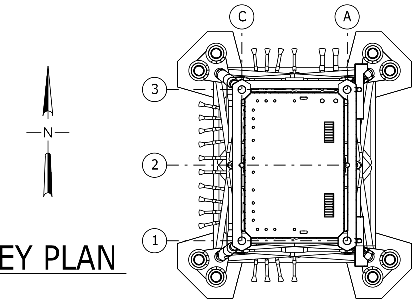
SECTION A
SCALE 1:10 -



SECTION B
SCALE 1:10 -

NOTES

1. FOR GENERAL NOTES SEE DRWG. NO. ROGE-N-GN-000012-01, -02 AND -03.
2. ALL STEELWORK ON THIS DRAWING IS IN ACC. WITH DNV-OS-C101 PRIMARY STRUCTURAL CATEGORY WITH MATERIAL CERTIFICATE 3.2 ACC. TO EN 10204 U.N.O.
3. WELDS TO BE INSPECTION CATEGORY II ACC. TO DNV-OS-C101 U.N.O.
4. ALL STEEL TO BE ST1 U.N.O.
5. FABRICATOR OF CABLE HANG OFF SUPPORT TO COORDINATE FLANGE TYPE WITH SUPPLIER OF CABLE HANG OFF ARRANGEMENT.



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
0	15-JAN-2016	FESA/BBR	STC	MXH	ISSUED FOR ITT
A	18-DEC-2015	FESA/MNI	STC	MXH	ISSUED FOR COMMENTS

Job no. 1100015665

TenneT
Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL

JACKET STRUCTURE
J-TUBES, HANG OFF SUPPORTS

Scale	Size	Drawing no.	Rev.
NOTED	A1	ROGE-N-XG-000007-21	0

FILENAME: X:\GlobalProjects\2015\1100015665\N-Structural\Substructure\Basic_design\phase\Deliverables\Drawings\ROGE-N-XG-000007-21...

OFFSHORE GRID NL

E3.1.6

Document Title:

Standard Offshore Substation Plotplans

03	05-09-2016	Issued for ITT, Information Notice 9	TenneT	TenneT	TenneT
02	12-07-2016	Issued for ITT, Information Notice 6	TenneT	TenneT	TenneT
01	15-01-2016	Issued for ITT			
00	15-01-2016	Issued for ITT			
Rev.	Revision date (DD-MM-YYYY)	Reason for issue	Prepared by	Verified by	Approved by

Project no.: 1100015665

Site code: Page: 1 of 20

TenneT Document No.:

ONL-TTB-00206

Update Revision 3, Information Notice 9

As announced in IN6. Complete update of plotplans to make them consistent.

Update Revision 2, Information Notice 6

Employer has received the preliminary dimensions of the Earthing/Auxiliary transformer and the Shunt Reactor and performed a small optimisation of the platform layout. The preliminary dimensions can be found in the Room Matrix (E3.1.10, ONL-TTB-00105).

The following changes have been implemented in the plotplans.

- Earthing/Auxiliary room A
  - The earthing/auxiliary transformers are rotated by 90 degrees
  - The brace in line B is moved to the cable deck
  - Two doors have been deleted
  - The laydown area in front of the earthing/auxiliary room A has been optimised

- Earthing/Auxiliary room B
  - An additional "Spare Room" is created. Originally the extra space inside the earthing/auxiliary room was foreseen for spares. Since the room is now naturally ventilated the room is less suitable for spares and a dedicated room is added.

- Shunt Reactor room A/B
  - The rooms sizes and external area are optimised.

There was insufficient time to update all drawings. As a result there are some inconsistencies between plotplans, elevations and isometrics. A complete revision of the plotplans will be issued before baseline.

In addition reference is made to the 3D model (E3.1.13, ONL-TTB-00003). The above stated changes have been implemented.

TenneT Taking power further	RAMBØLL Job no. 1100015665	PROJECT OFFSHORE GRID NL					
			3	31-AUG-2016	ELO	MAH	MVJ
			2	08-JUL-2016	MAH	ELO	KAR
			1	20-JAN-2016	MAH	ELO	KAR
			0	15-JAN-2016	ABDL/ELO	MAH	KAR
DRAWING LIST		STANDARD 700 MW AC OFFSHORE SUBSTATION	C	27-NOV-2015	ABDL	MAH	KAR
			REV.	DATE	MADE BY	CHECKED	APPROVED

PLATFORM : 700 MW AC OFFSH. SUBSTATION

DISCIPLINE 02 - PLOTPLANS

DENOMINATOR	PLATFORM		MODULE	DISCI-PLINE	SEQ. NO	SHEET NO	DRAWING TITLE:	DRAW. SIZE	DRAWN BY	CAD	MAINT. SYSTEM	REVI-SION	REVISION DATE	REMARKS:
	T	T	B	02	001	01	CABLE DECK EL. 20.000 T.O.S.	A1	100970	I	-	2	08-JUL-2016	
	T	T	C	02	001	01	MAIN DECK EL. 26.500 T.O.S	A1	100970	I	-	2	08-JUL-2016	
	T	T	D	02	001	01	SPARE	A1	100970	I	-	-	-	
	T	T	E	02	001	01	UTILITY DECK EL. 34.000 T.O.S	A1	100970	I	-	2	08-JUL-2016	
	T	T	F	02	001	01	CONTROL DECK EL. 38.000 T.O.S	A1	100970	I	-	2	29-AUG-2016	
	T	T	G	02	001	01	ROOF DECK EL. 42.000 / 44.000 T.O.S	A1	100970	I	-	2	29-AUG-2016	
	T	T	Z	02	001	01	ELEVATION LOOKING EAST	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	002	01	ELEVATION LOOKING NORTH	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	003	01	ELEVATION LOOKING EAST (WITH JACKET)	A1	100970	I	-	1	08-JUL-2016	
	T	T	Z	02	004	01	ELEVATION LOOKING NORTH (WITH JACKET)	A1	100970	I	-	1	08-JUL-2016	
	T	T	Z	02	005	01	SPARE							
	T	T	Z	02	006	01	ELEVATION LOOKING SOUTH	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	007	01	ELEVATION LOOKING EAST	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	008	01	ISOMETRIC VIEW, LOOKING NORTH/EAST (WITH JACKET)	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	009	01	ISOMETRIC VIEW, LOOKING SOUTH/WEST (WITH JACKET)	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	010	01	ISOMETRIC VIEW, LOOKING NORTH/WEST	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	011	01	ISOMETRIC VIEW, LOOKING SOUTH/WEST	A1	100970	I	-	1	29-AUG-2016	
	T	T	Z	02	012	01	ISOMETRIC VIEW, LOOKING NORTH/WEST	A1	100970	I	-	1	29-AUG-2016	
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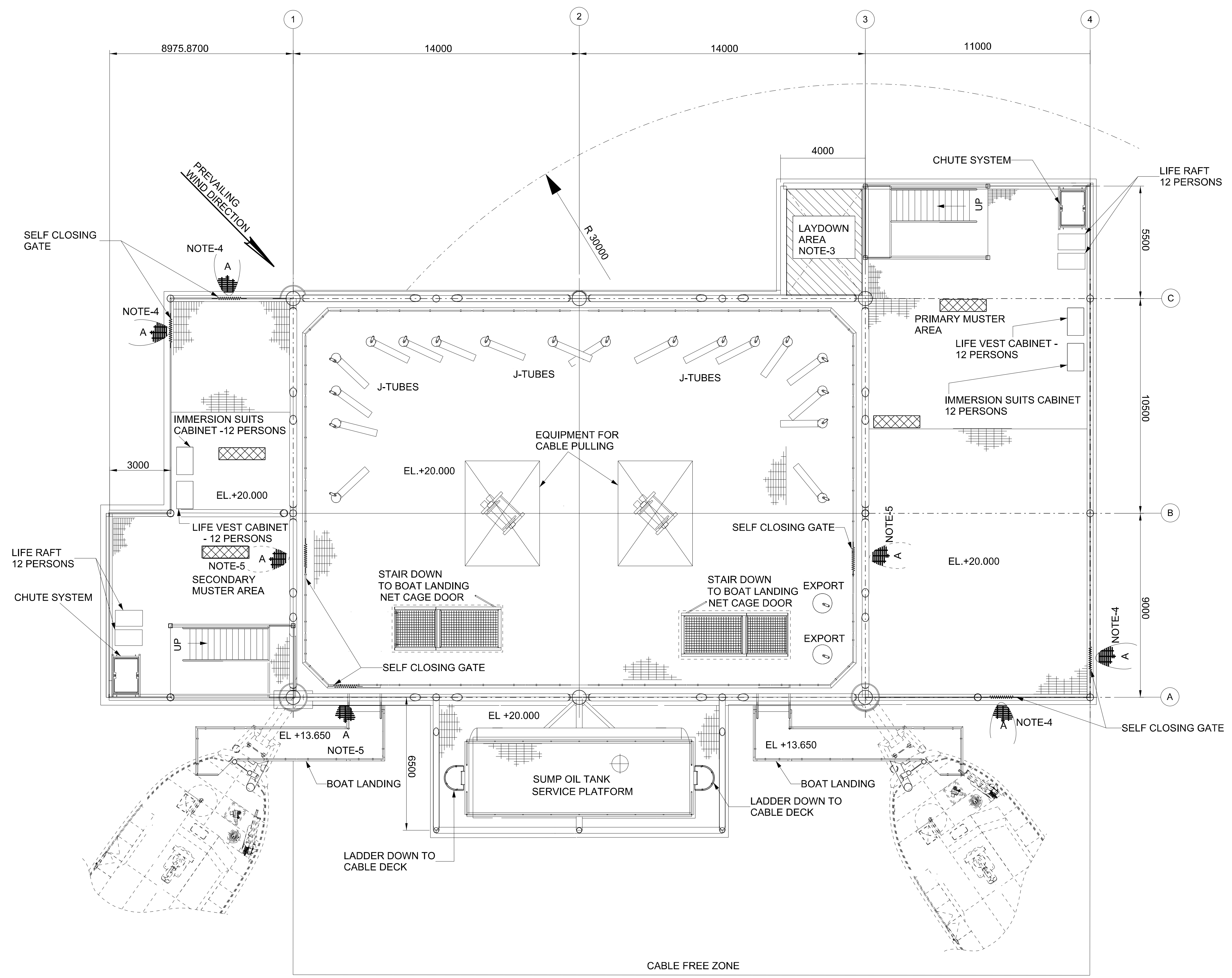
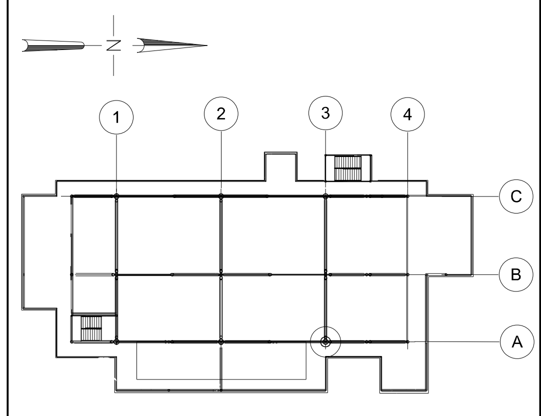


NOTES

1. DIMENSIONS IN MM
2. LEVELS IN M. REFERENCE TO LAT
3. LAYDOWN AREA TO BE PAINTED YELLOW, HANDRAIL ON LAYDOWN AREA SHOULD BE HEAVY DUTY TYPE
4. WALK TO WORK ACCESS AREA
5. WALK TO WORK ACCESS AREA BEFORE TOPSIDE INSTALLATION



KEY PLAN

LEGEND:

- HANDRAIL
- SELF CLOSING GATE
- GRATING
- PLATE DECK
- LAYDOWN AREA (PLATE DECK 15 KN/m2)
- MUSTER AREA
- INTRUDER BARRIER

CABLE DECK - EL.+20.000 T.O.S

SCALE 1:100

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
2	08.07.2016	ELO	MVJ	MVJ	RE-ISSUED FOR ITT
1	20.01.2016	SKK	ABDL	KAR	RE-ISSUED FOR ITT
0	15.01.2016	SKK	ABDL	KAR	ISSUED FOR ITT
C	27.11.2015	GANK	ABDL	KAR	RE-ISSUED FOR COMMENTS
B	16.10.2015	SKK	MAH	KAR	RE-ISSUED FOR COMMENTS
A	30.06.2015	MAH	KAR	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

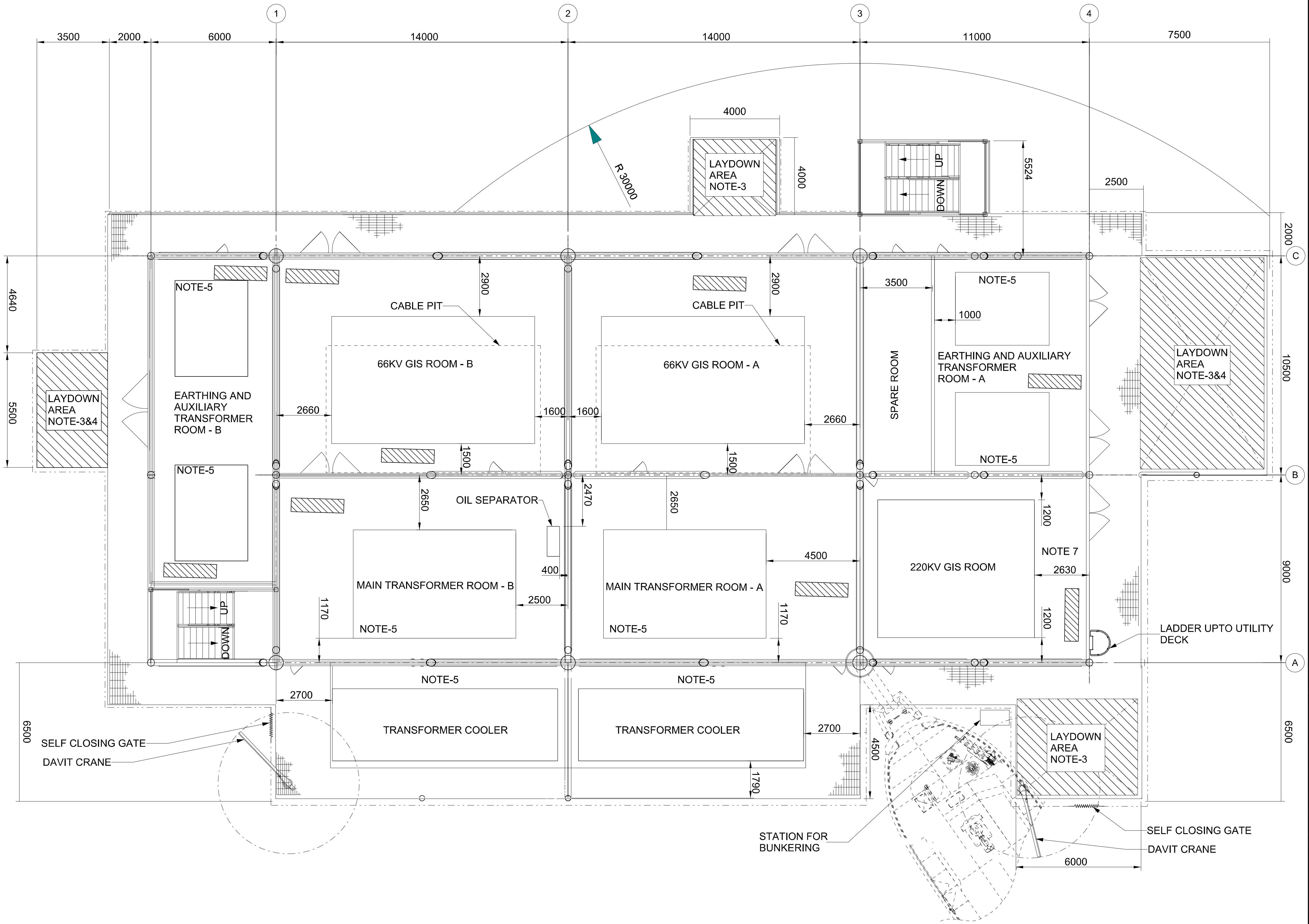
Title

OFFSHORE GRID NL

CABLE DECK - PLOTPLAN

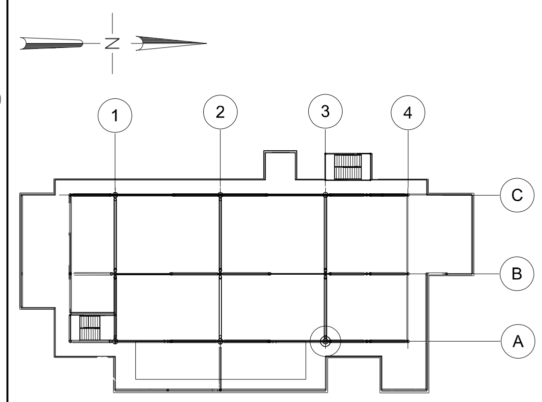
EL.20.000 T.O.S

Scale	Size	Drawing no.	Rev.
NOTED	A1	TT-B-02-001-01	2



NOTES

1. DIMENSIONS IN MM
2. LEVELS IN M. REFERENCE TO LAT
3. LAYDOWN AREA TO BE PAINTED YELLOW, HANDRAIL ON LAYDOWN AREA SHOULD BE HEAVY DUTY TYPE
4. LAYDOWN TO SHIP
5. GRATING AND DRIP TRAY BELOW MAIN TRANSFORMER,TRANSFORMER COOLER, EARTHING AND AUXILIARY TRANSFORMER
6. THE MAIN DECK ELEVATION SHALL BE OF EL. +27.500 TOS.
7. ROOM DIMENSION HAS TO BE MINIMUM 11000 MM INSIDE



KEY PLAN

LEGEND:

- HANDRAIL
- SELF CLOSING GATE
- GRATING
- PLATE DECK
- LAYDOWN AREA (PLATE DECK 15 KN/m2)

MAIN DECK - EL.+26.500 T.O.S (NOTE-6)

SCALE 1:100

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
2	08.07.2016	ELO	MVJ	MVJ	RE-ISSUED FOR ITT
1	20.01.2016	SKK	ABDL	KAR	RE-ISSUED FOR ITT
0	15.01.2016	SKK	ABDL	KAR	ISSUED FOR ITT
C	27.11.2015	GANK	ABDL	KAR	RE-ISSUED FOR COMMENTS
B	16.10.2015	SKK	MAH	KAR	RE-ISSUED FOR COMMENTS
A	30.06.2015	MAH	KAR	KAR	ISSUED FOR COMMENTS

Job no. 1100015665

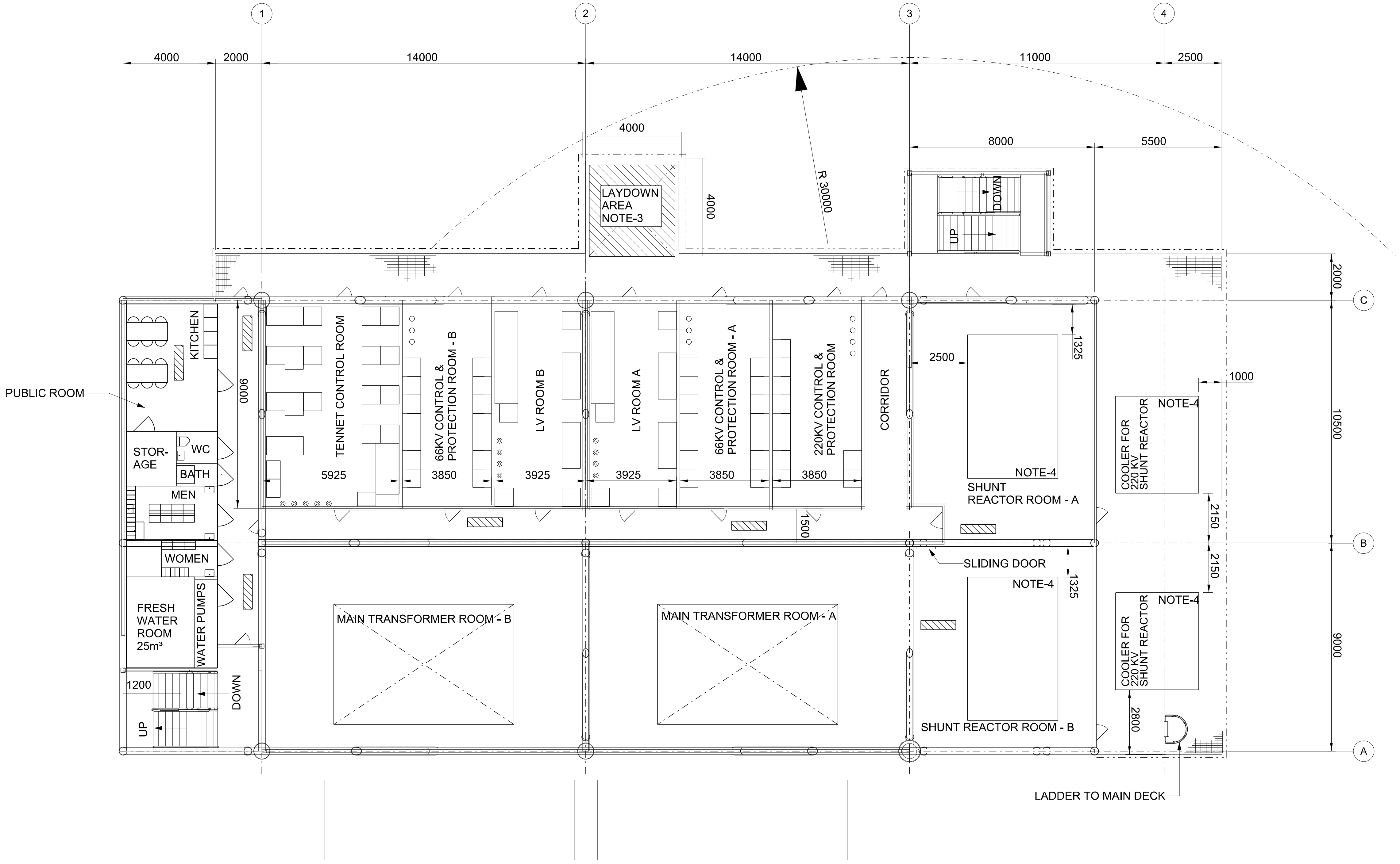
STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
MAIN DECK - PLOTPLAN
EL.26.500 T.O.S

Scale	Size	Drawing no.	Rev.
NOTED	A1	TT-C-02-001-01	2

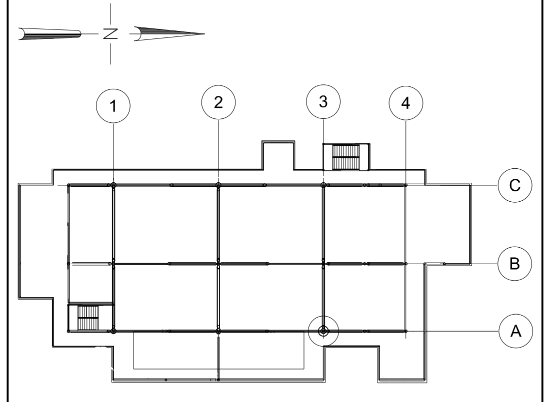
NOTES

1. DIMENSIONS IN MM
2. LEVELS IN M. REFERENCE TO LAT
3. LAYDOWN AREA TO BE PAINTED YELLOW HANDRAIL ON LAYDOWN AREA SHOULD BE HEAVY DUTY TYPE
4. GRATING AND DRIP TRAY BELOW SHUNT REACTOR AND SHUNT REACTOR COOLER
5. THE UTILITY DECK ELEVATION SHALL BE OF +35.000 T.O.S



UTILITY DECK - EL. +34.000 T.O.S. (NOTE-5)

SCALE 1:100



KEY PLAN

LEGEND:

- HANDRAIL
- GRATING
- PLATE DECK
- LAYDOWN AREA (PLATE DECK 15 KN/m2
- INERT GAS BOTTLES

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
2	08.07.2016	ELO	MVJ	MVJ	RE-ISSUED FOR ITT
1	20.01.2016	SKK	ABDL	KAR	RE-ISSUED FOR ITT
0	15.01.2016	SKK	ABDL	KAR	ISSUED FOR ITT
C	27.11.2015	GANK	ABDL	KAR	RE-ISSUED FOR COMMENTS
B	16.10.2015	SKK	MAH	KAR	RE-ISSUED FOR COMMENTS
A	30.06.2015	MAH	KAR	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

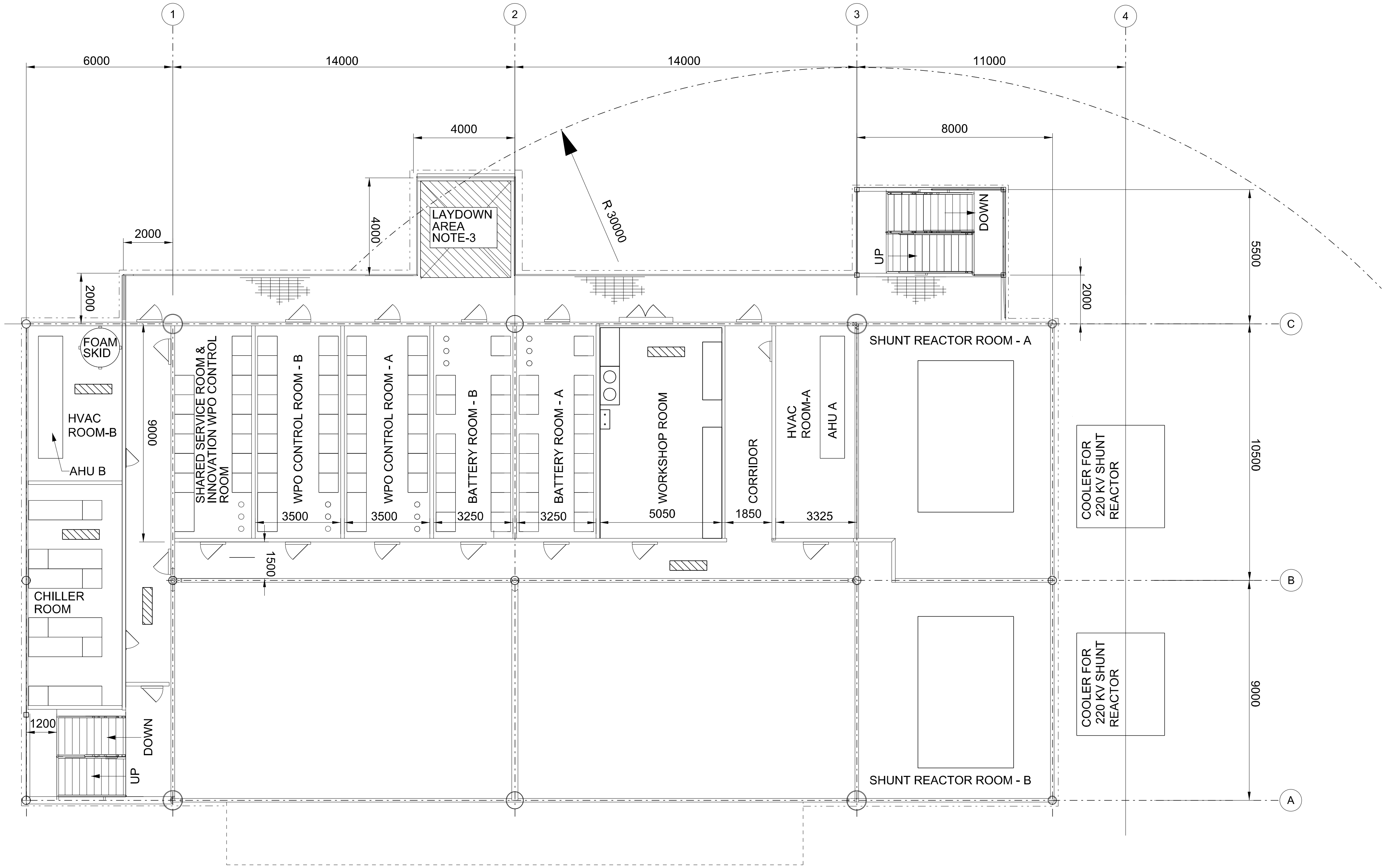
OFFSHORE GRID NL
UTILITY DECK - PLOTPLAN
EL. 34.000 T.O.S

Scale	Size	Drawing no.	Rev.
NOTED	A1	TT-E-02-001-01	2

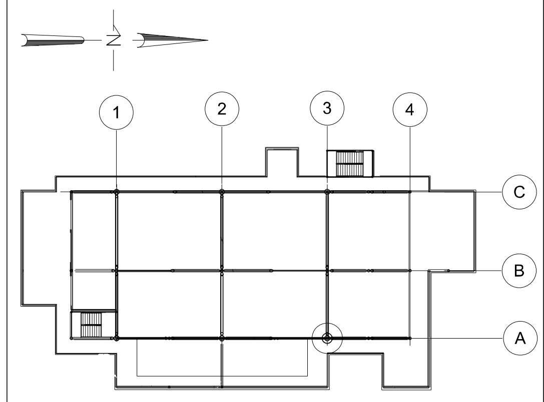
FILENAME: X:\GlobalProjects\2015\1100015665\R-Mechanical_Drawings\Drawings List Rev. 3 - Drawings\New folder\TT-E-02-001-01.dwg 2016 12:02:44 PM

NOTES

1. DIMENSIONS IN MM
2. LEVELS IN M. REFERENCE TO LAT
3. LAYDOWN AREA TO BE PAINTED YELLOW HANDRAIL ON LAYDOWN AREA SHOULD BE HEAVY DUTY TYPE
4. THE CONTROL DECK ELEVATION SHALL BE OF +39.000 T.O.S



CONTROL DECK - EL. +38.000 T.O.S (NOTE - 4)
SCALE 1:100



KEY PLAN

LEGEND:

- HANDRAIL
- GRATING
- PLATE DECK
- LAYDOWN AREA (PLATE DECK 15 KN/m2)

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
2	29.08.2016	GANK	ABDL	KAR	RE-ISSUED FOR ITT
1	20.01.2016	SKK	ABDL	KAR	RE-ISSUED FOR ITT
0	15.01.2016	SKK	ABDL	KAR	ISSUED FOR ITT
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B	16.10.2015	MAH	KAR	KAR	RE-ISSUED FOR COMMENTS
A	30.06.2015	KAR	KAR	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700 MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
CONTROL DECK - PLOTPLAN
EL. 38.000 T.O.S

Scale	Size	Drawing no.	Rev.
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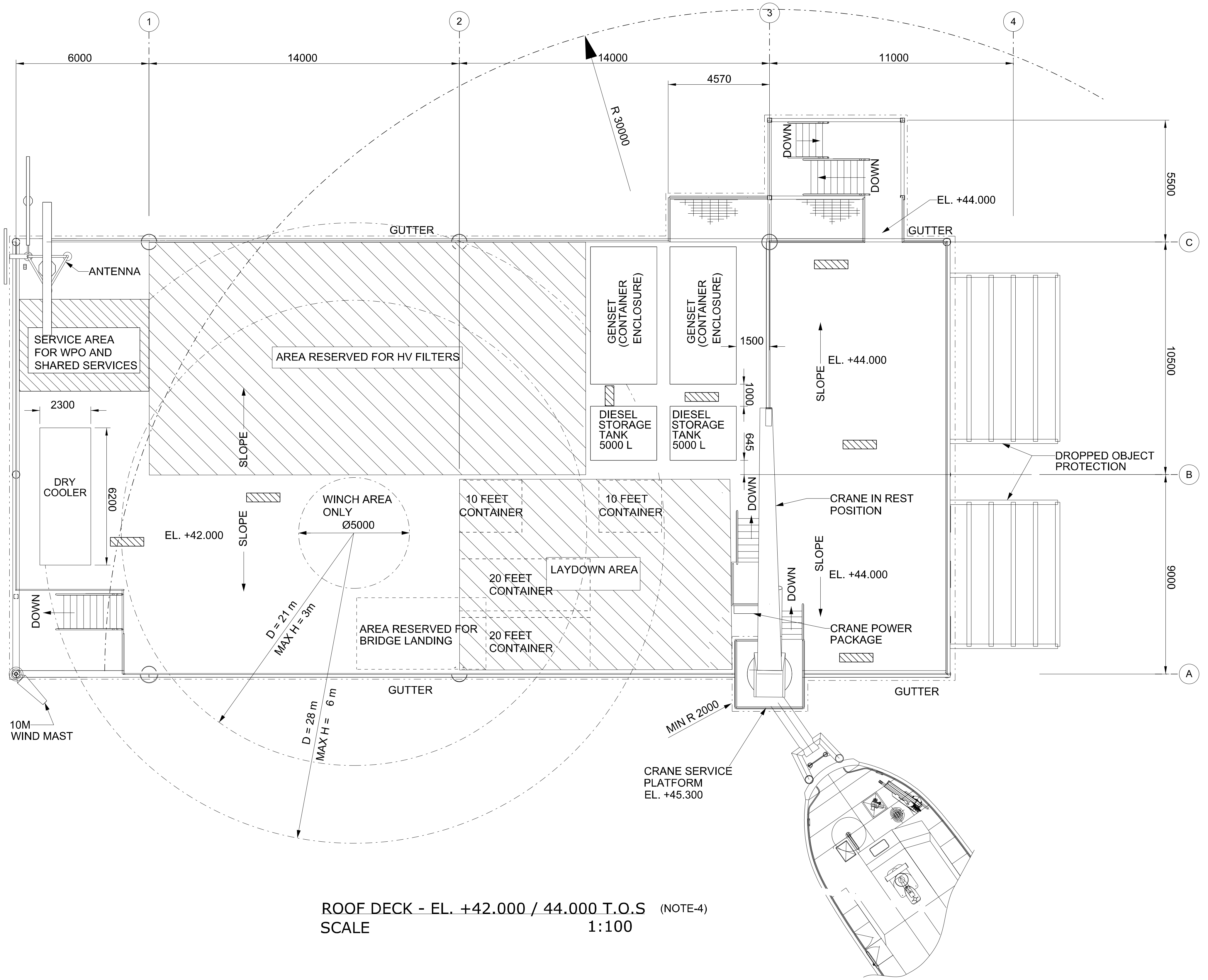


ROOF DECK - EL. +42.000 / 44.000 T.O.S (NOTE-4)

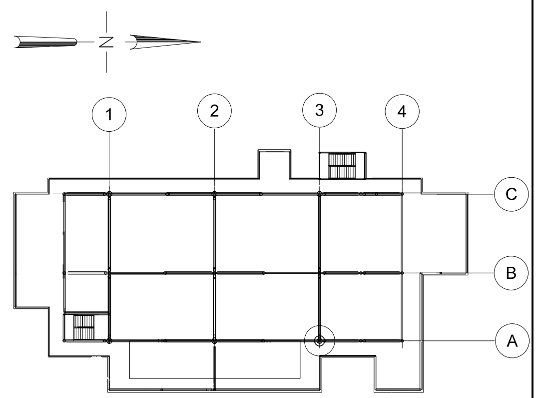
SCALE 1:100

LEGEND:

- HANDRAIL
- GRATING
- PLATE DECK
- LAYDOWN AREA (PLATE DECK 15KN/m2)

NOTES

1. DIMENSIONS IN MM.
2. LEVELS IN M. REFERENCE TO LAT
3. LAYDOWN AREA TO BE PAINTED YELLOW, HANDRAIL ON LAYDOWN AREA SHOULD BE HEAVY DUTY TYPE
4. THE ROOF DECK ELEVATION SHALL BE OF +43.000 / + 45.000 T.O.S



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Drawing no.	Reference dwgs.

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C	27.11.2015	NRR	ABDL	KAR	RE-ISSUED FOR COMMENTS
B	16.10.2015	SKK	MAH	KAR	RE-ISSUED FOR COMMENTS
A	30.06.2015	MAH	KAR	KAR	ISSUED FOR COMMENTS

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Job no. 1100015665

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STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

ROOF DECK - PLOTPLAN
EL.+ 42.000 / +44.000 T.O.S

Scale	Size	Drawing no.	Rev.
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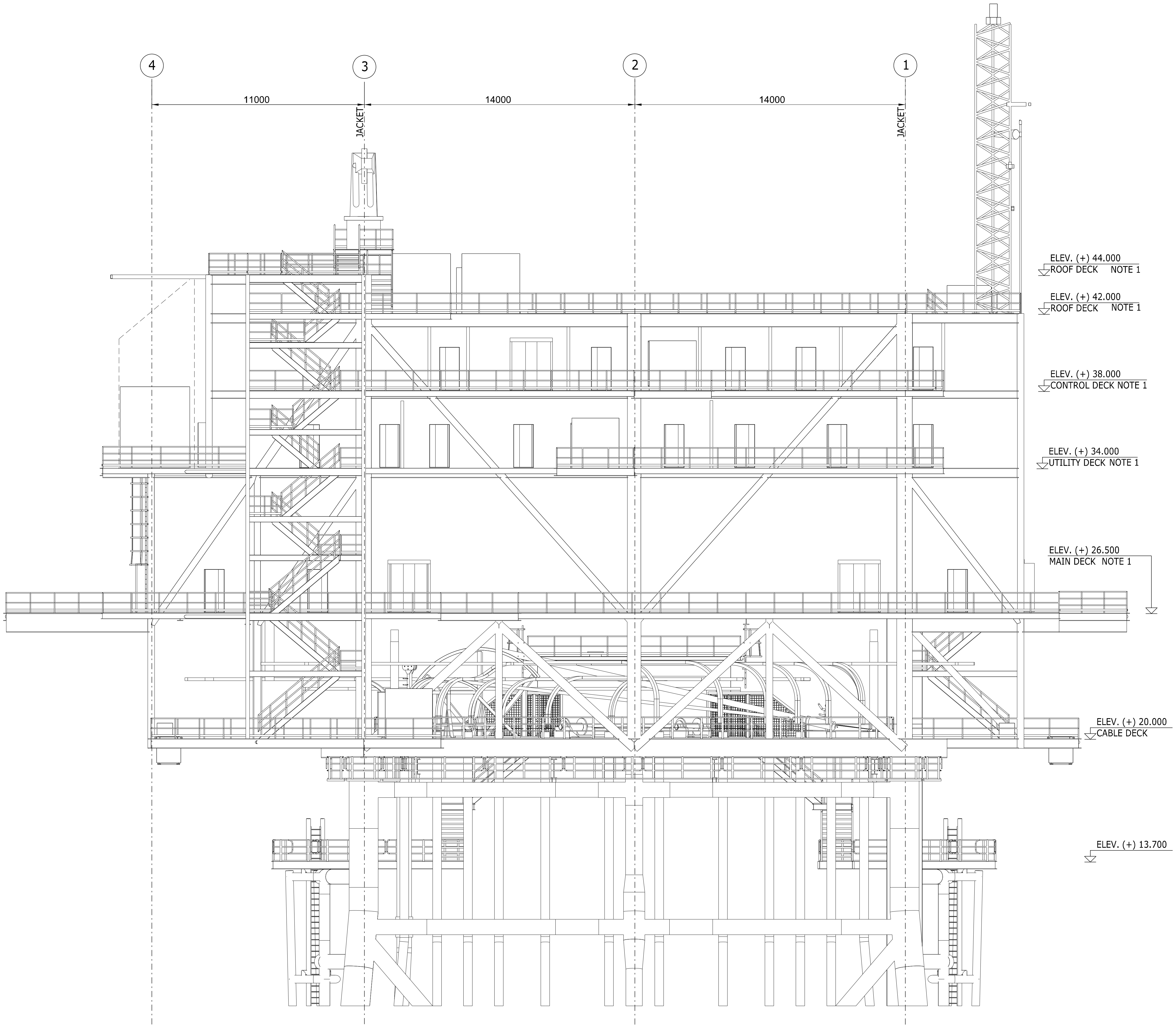

ELEVATION, LOOKING EAST

SCALE 1:100

NOTES

1. ELEVATION TO BE RAISED 1000 mm
   - MAIN DECK: EL + 27.500 T.O.S.
   - UTILITY DECK: EL + 35.000 T.O.S.
   - CONTROL DECK: EL + 39.000 T.O.S.
   - ROOF DECK: EL + 43.000/45.000 T.O.S.

Drawing no. | Reference dwgs.

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B	27.11.2015	KBC	MAH	KAR	RE-ISSUED FOR COMMENTS
A	30.06.2015	ELO	KAR	KAR	ISSUED FOR COMMENTS

Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
PLOTPLAN
ELEVATION, LOOKING EAST

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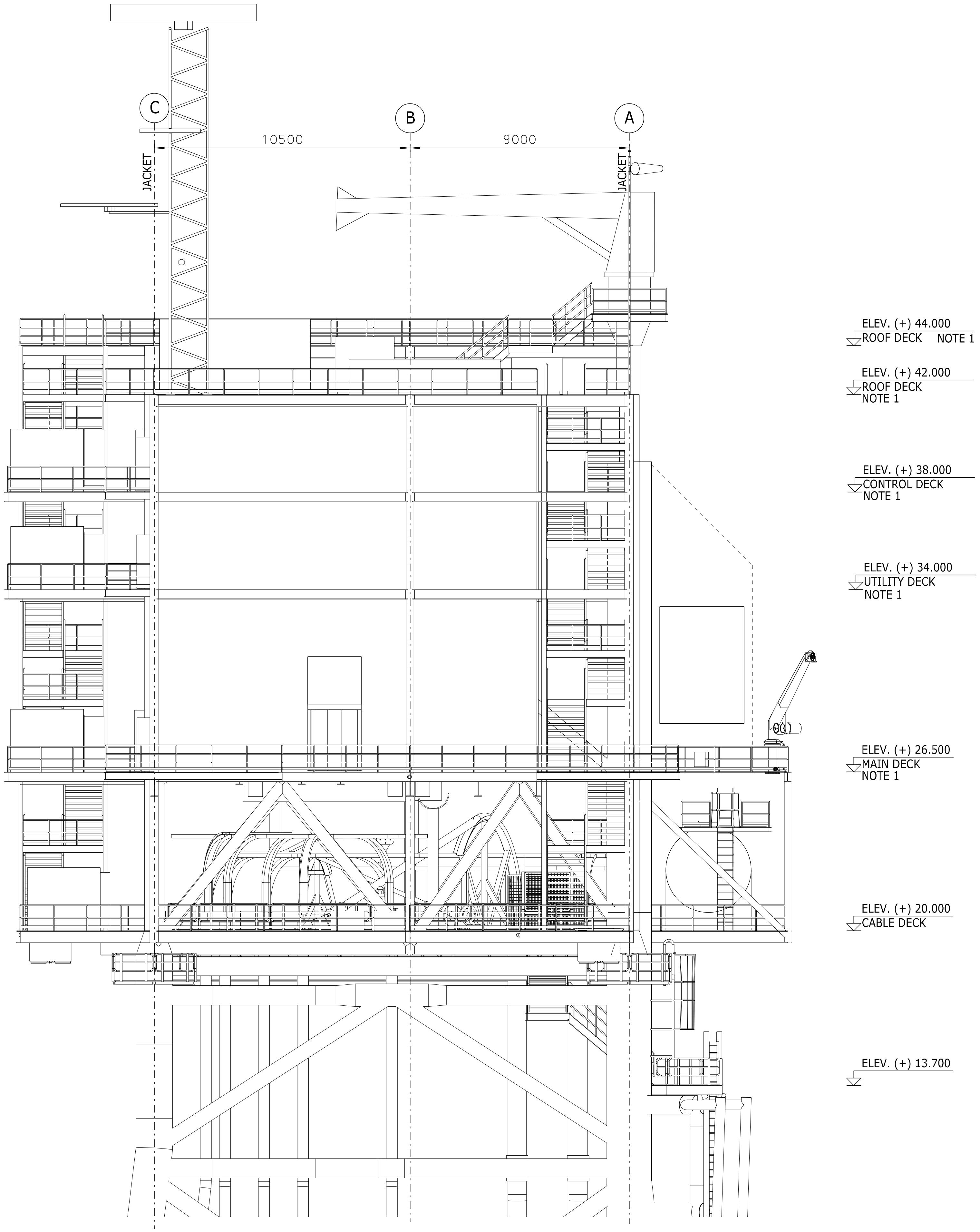

ELEVATION, LOOKING NORTH

SCALE 1:100

NOTES

1. ELEVATION TO BE RAISED 1000 mm
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   - UTILITY DECK: EL + 35.000 T.O.S.
   - CONTROL DECK: EL + 39.000 T.O.S.
   - ROOF DECK: EL + 43.000/45.000 T.O.S.

Drawing no.	Reference dwgs.

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B	27.11.2015	KBC	MAH	KAR	RE-ISSUED FOR COMMETS
A	30.06-2015	ELO	KAR	KAR	ISSUED FOR COMMENTS

Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOTPLAN

ELEVATION, LOOKING NORTH

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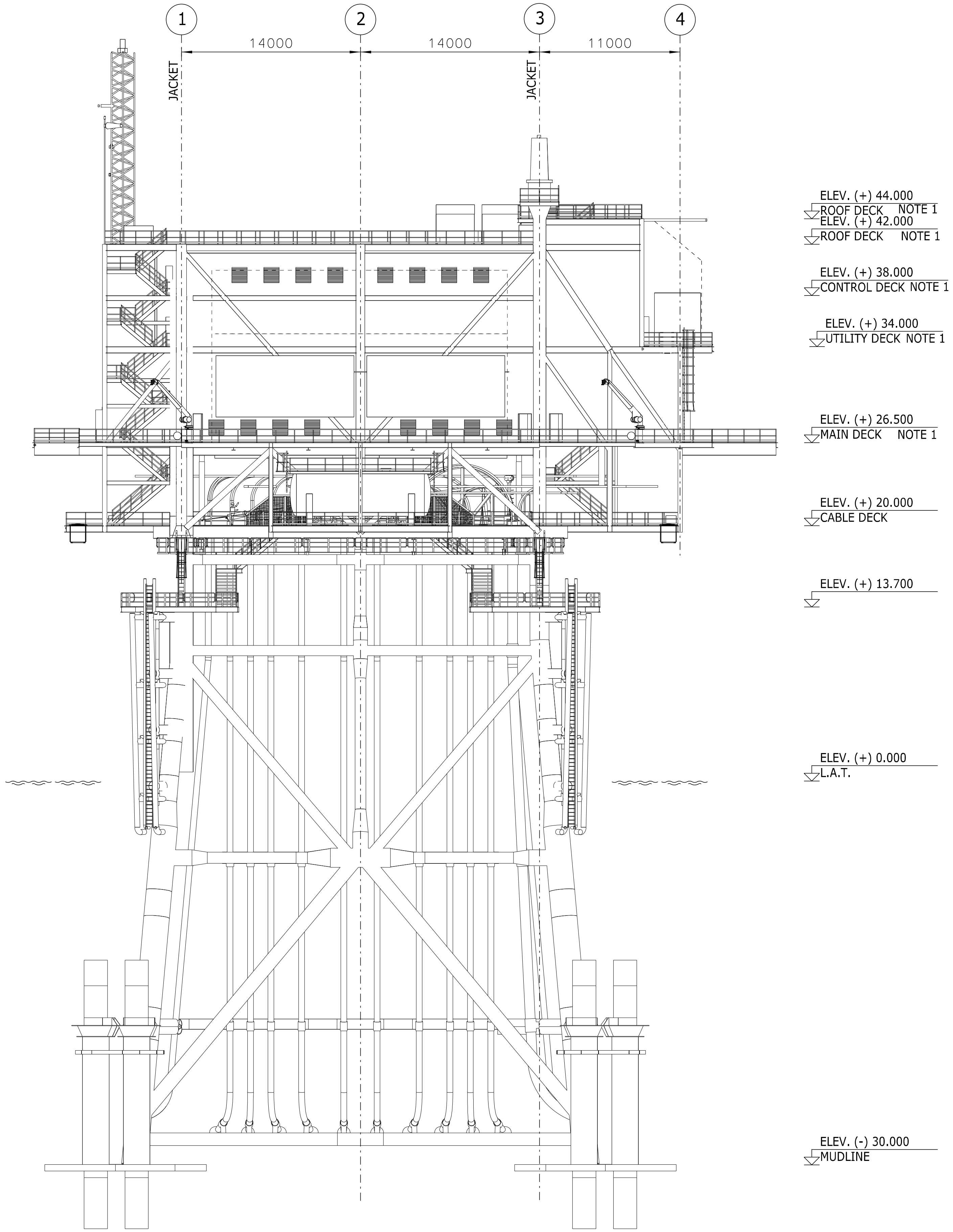

ELEVATION, LOOKING EAST

SCALE 1:200

NOTES

1. ELEVATION TO BE RAISED 1000 mm
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   - CONTROL DECK: EL + 39.000 T.O.S.
   - ROOF DECK: EL + 43.000/45.000 T.O.S.

Drawing no.	Reference dwgs.

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A	30.06.2015	ELO	KAR	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOTPLAN

ELEVATION, LOOKING EAST (WITH JACKET)

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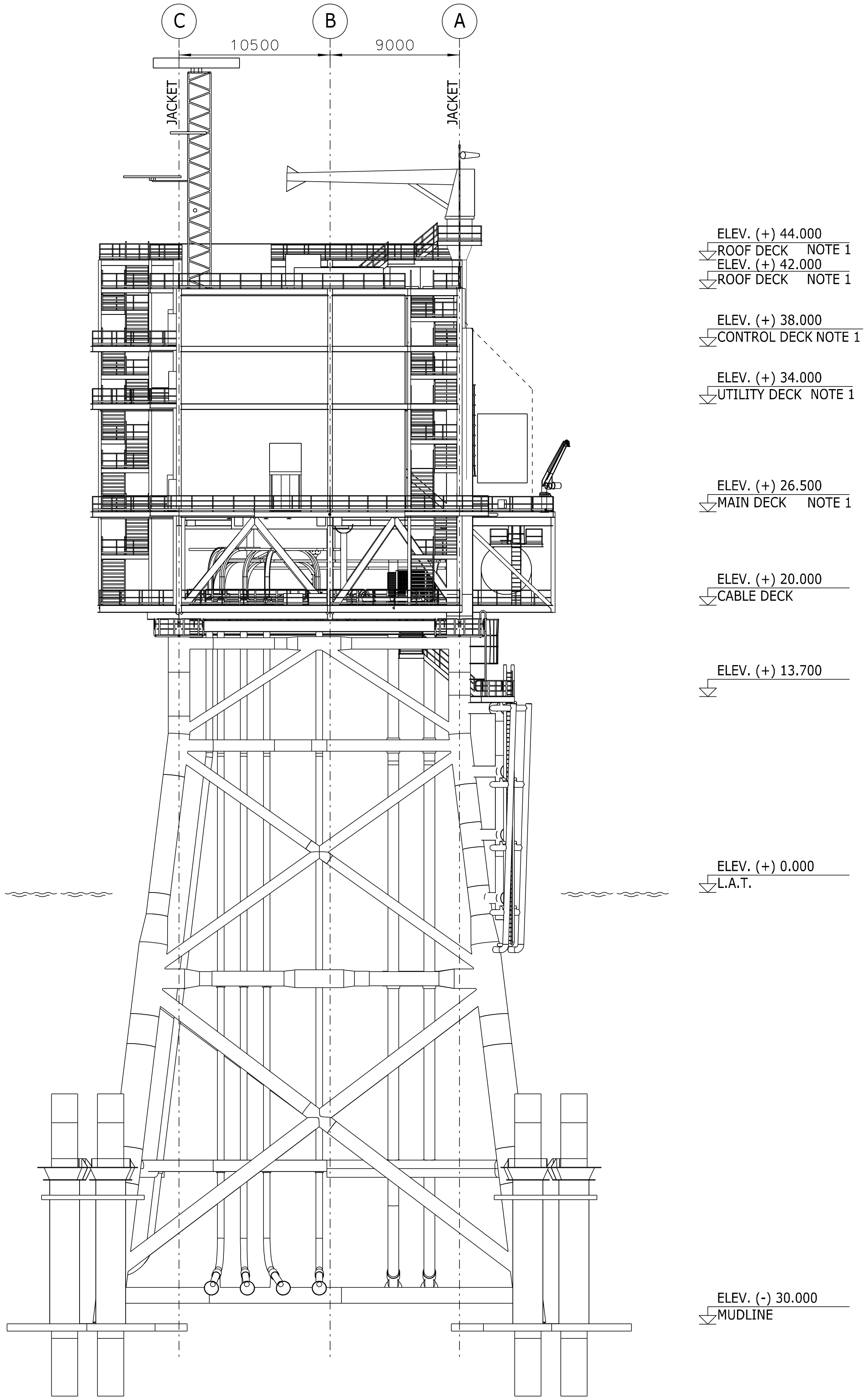

ELEVATION, LOOKING NORTH

SCALE 1:200

NOTES

1. ELEVATION TO BE RAISED 1000 mm
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   - UTILITY DECK: EL + 35.000 T.O.S.
   - CONTROL DECK: EL + 39.000 T.O.S.
   - ROOF DECK: EL + 43.000/45.000 T.O.S.

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A	30.06-2015	ELO	KAR	KAR	ISSUED FOR COMMENTS
Rev	Date	Drawn	Chkd	Appr	Description

Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOTPLAN

ELEVATION, LOOKING NORTH (WITH JACKET)

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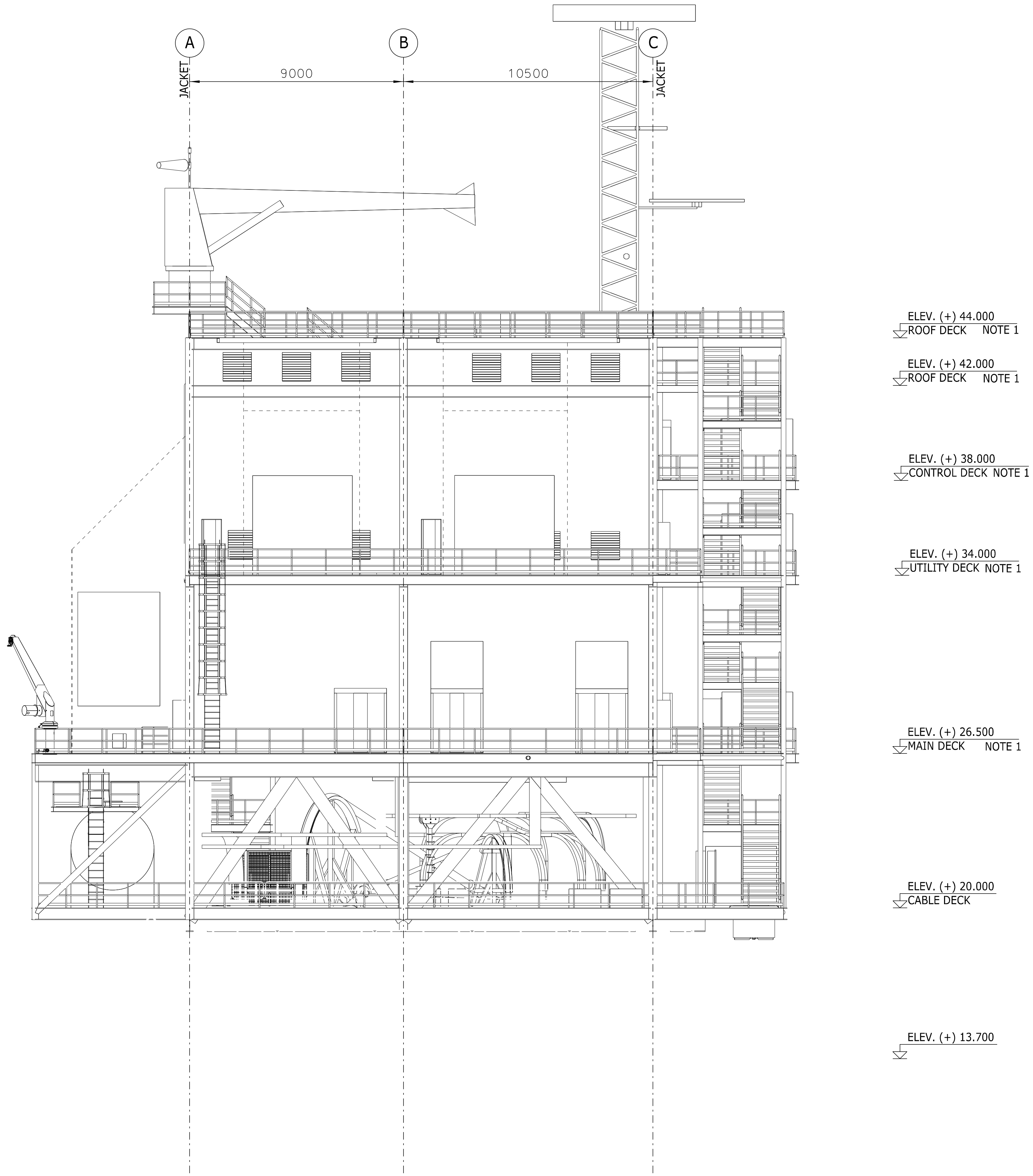

ELEVATION, LOOKING SOUTH

SCALE 1:100

NOTES

1. ELEVATION TO BE RAISED 1000 mm
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   - CONTROL DECK: EL + 39.000 T.O.S.
   - ROOF DECK: EL + 43.000/45.000 T.O.S.

Drawing no.	Reference dwgs.

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A	27.11.2015	KBC	MAH	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOTPLAN

ELEVATION, LOOKING SOUTH

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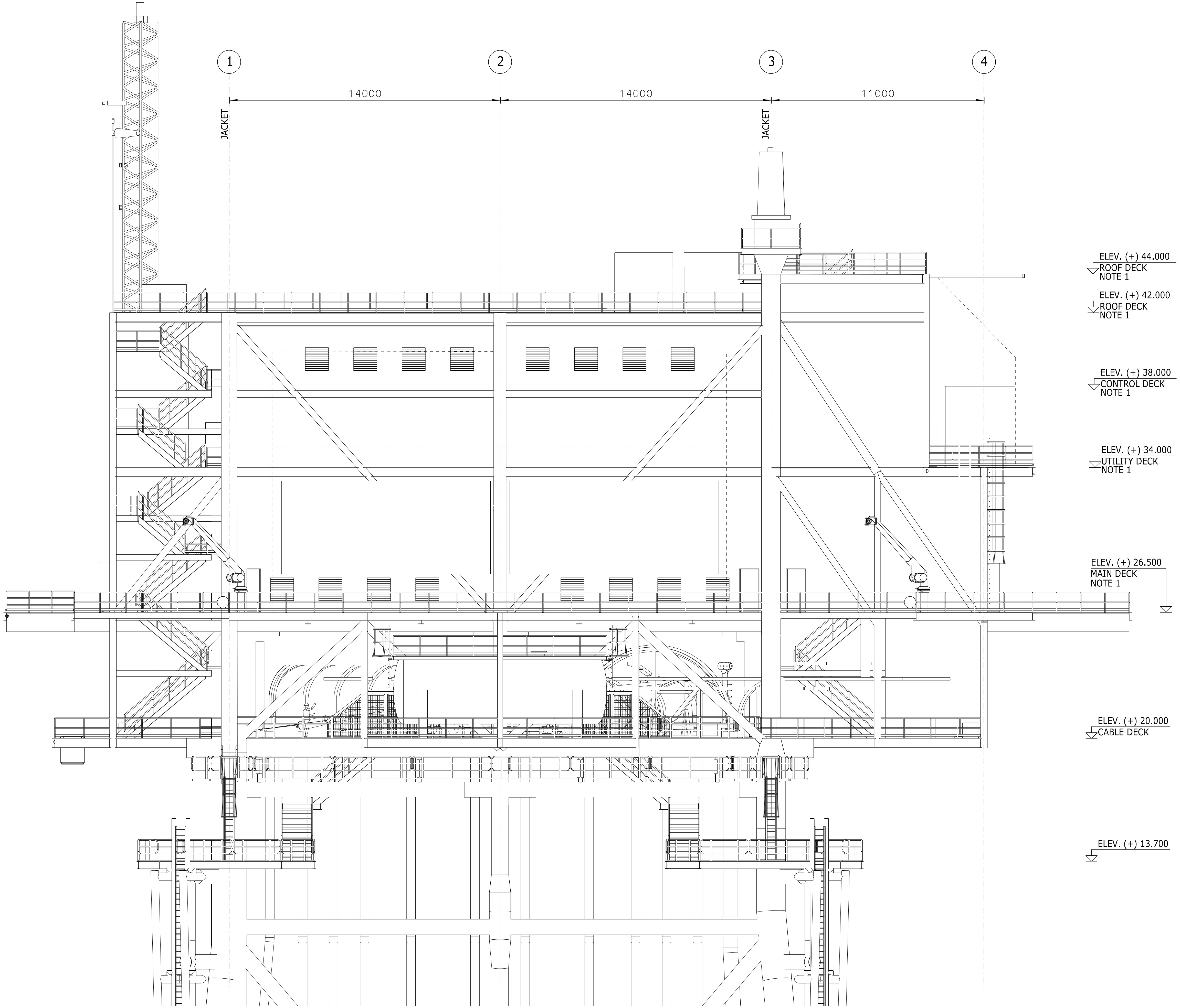

ELEVATION, LOOKING WEST

SCALE 1:100

NOTES

1. ELEVATION TO BE RAISED 1000 mm
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   - CONTROL DECK: EL + 39.000 T.O.S.
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A	27.11.2015	KBC	MAH	KAR	ISSUED FOR COMMENTS

Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOTPLAN
ELEVATION, LOOKING WEST

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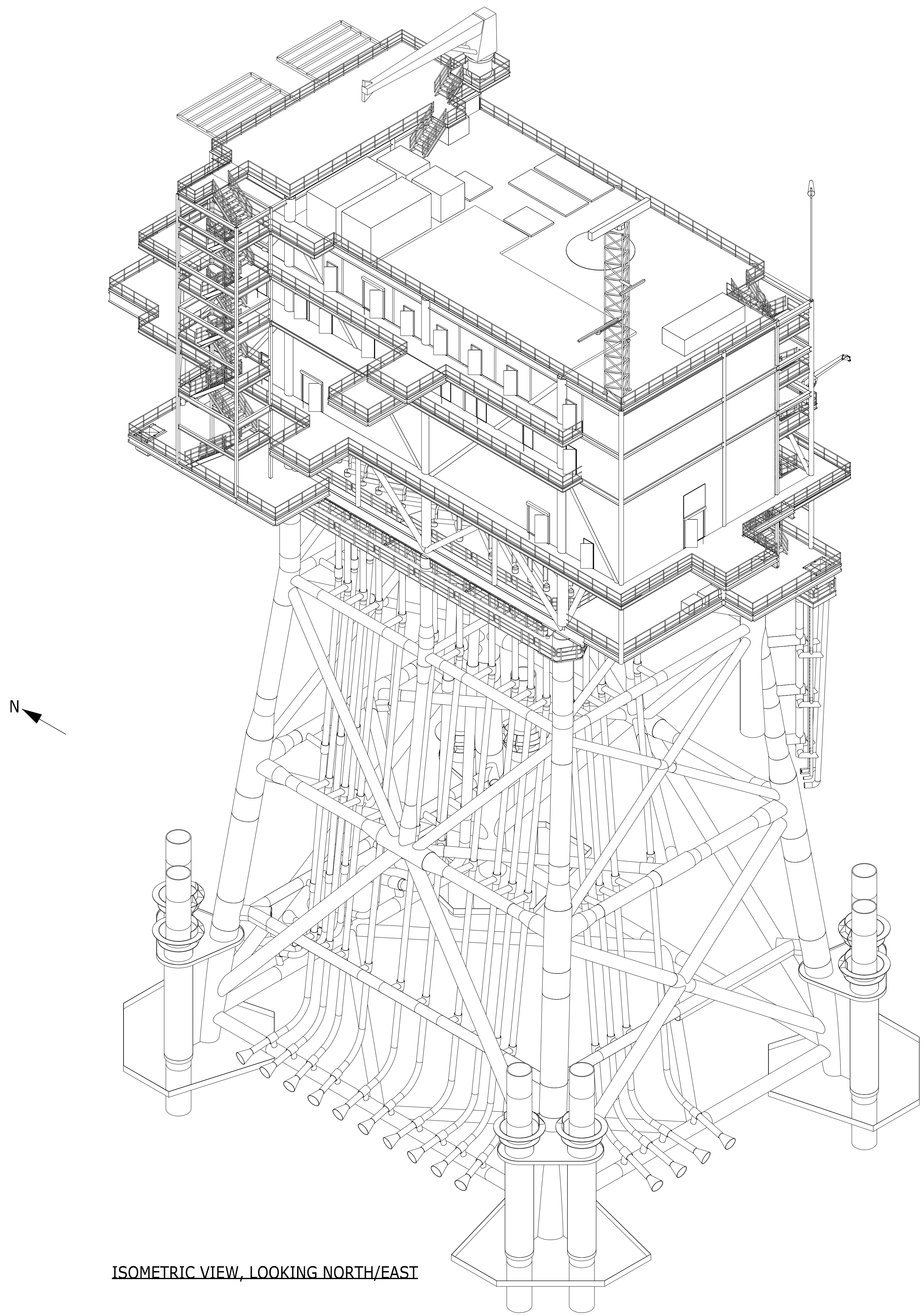

ISOMETRIC VIEW, LOOKING NORTH/EAST

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A	27.11.2015	KBC	MAH	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT — Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
PLOT PLAN
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(WITH JACKET)

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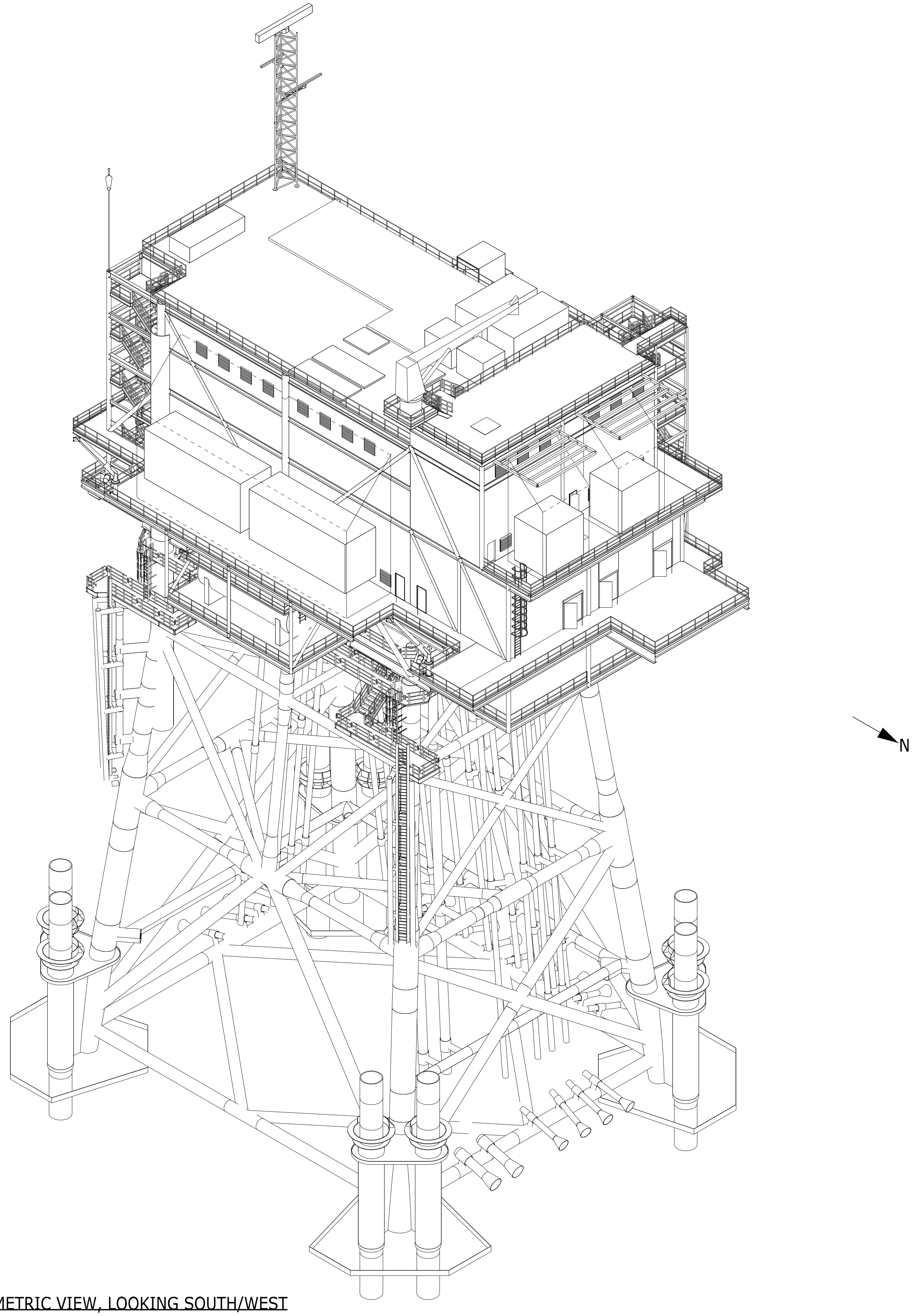

ISOMETRIC VIEW, LOOKING SOUTH/WEST

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A	27.11.2015	KBC	MAH	KAR	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
PLOT PLAN
ISOMETRIC VIEW, LOOKING SOUTH/WEST
(WITH JACKET)

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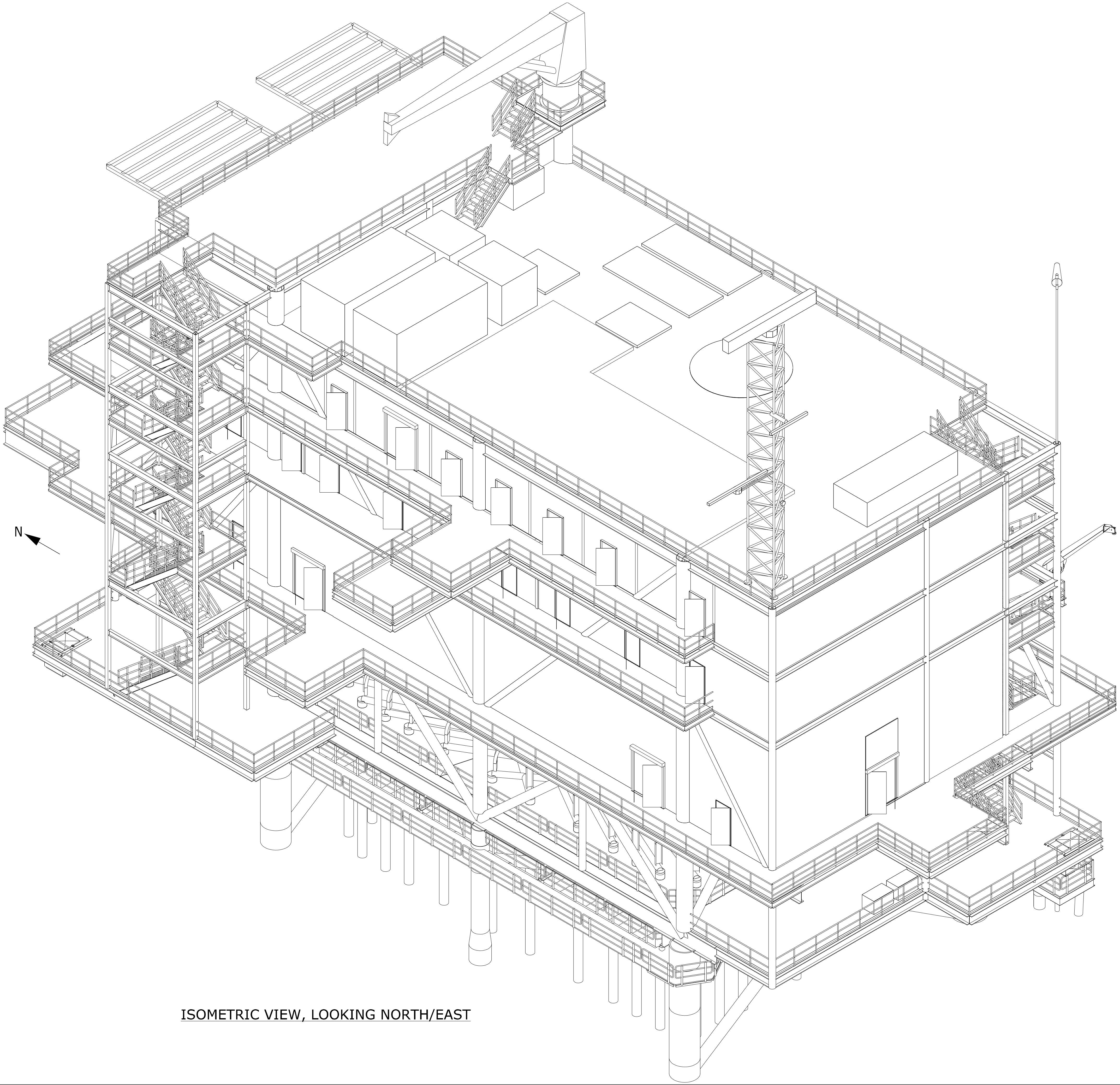

ISOMETRIC VIEW, LOOKING NORTH/EAST

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A	27.11.2015	KBC	MAH	KAR	ISSUED FOR COMMENTS

Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOT PLAN

ISOMETRIC VIEW, LOOKING NORTH/EAST

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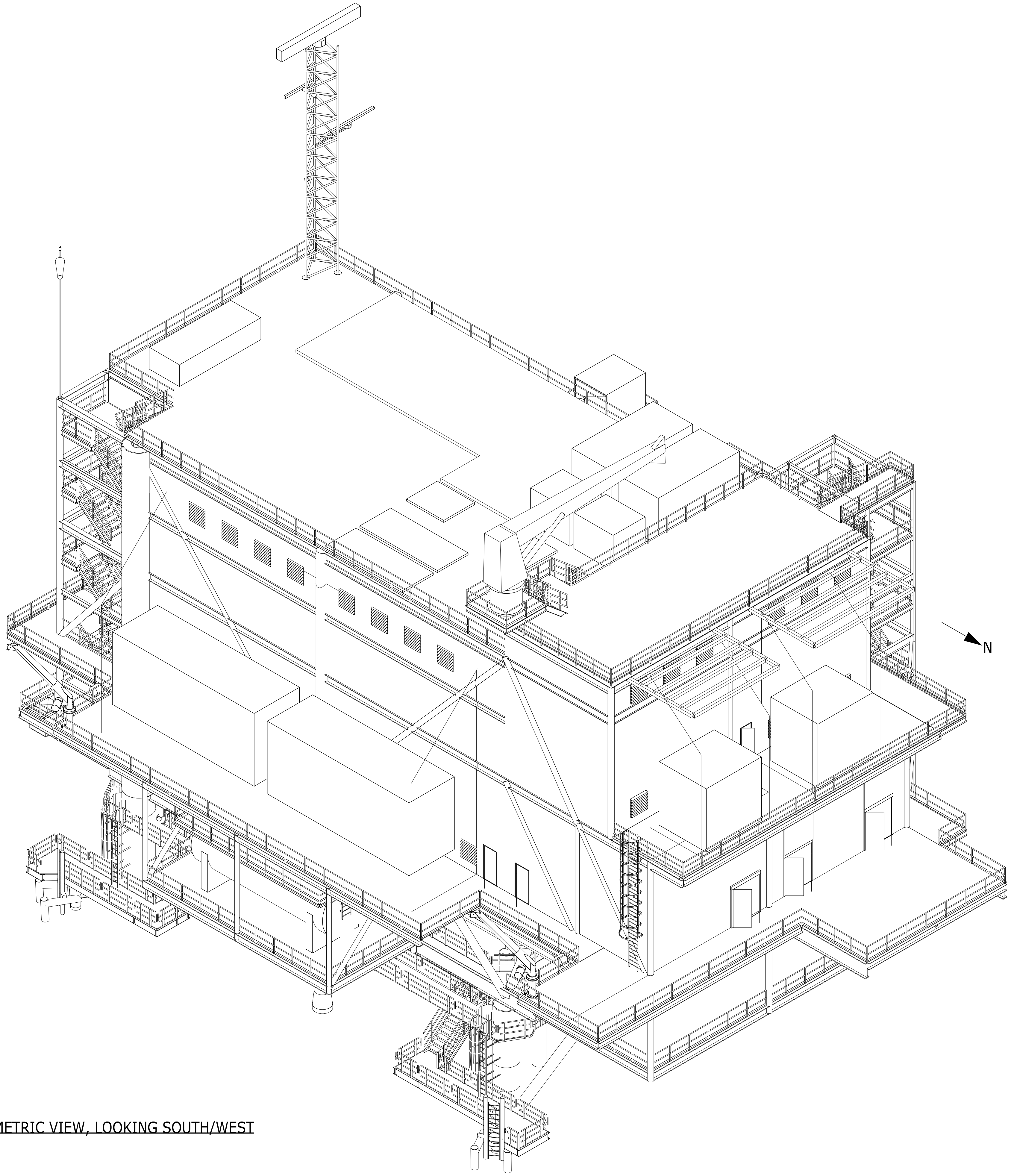

ISOMETRIC VIEW, LOOKING SOUTH/WEST

NOTES

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Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
PLOT PLAN
ISOMETRIC VIEW, LOOKING SOUTH/WEST

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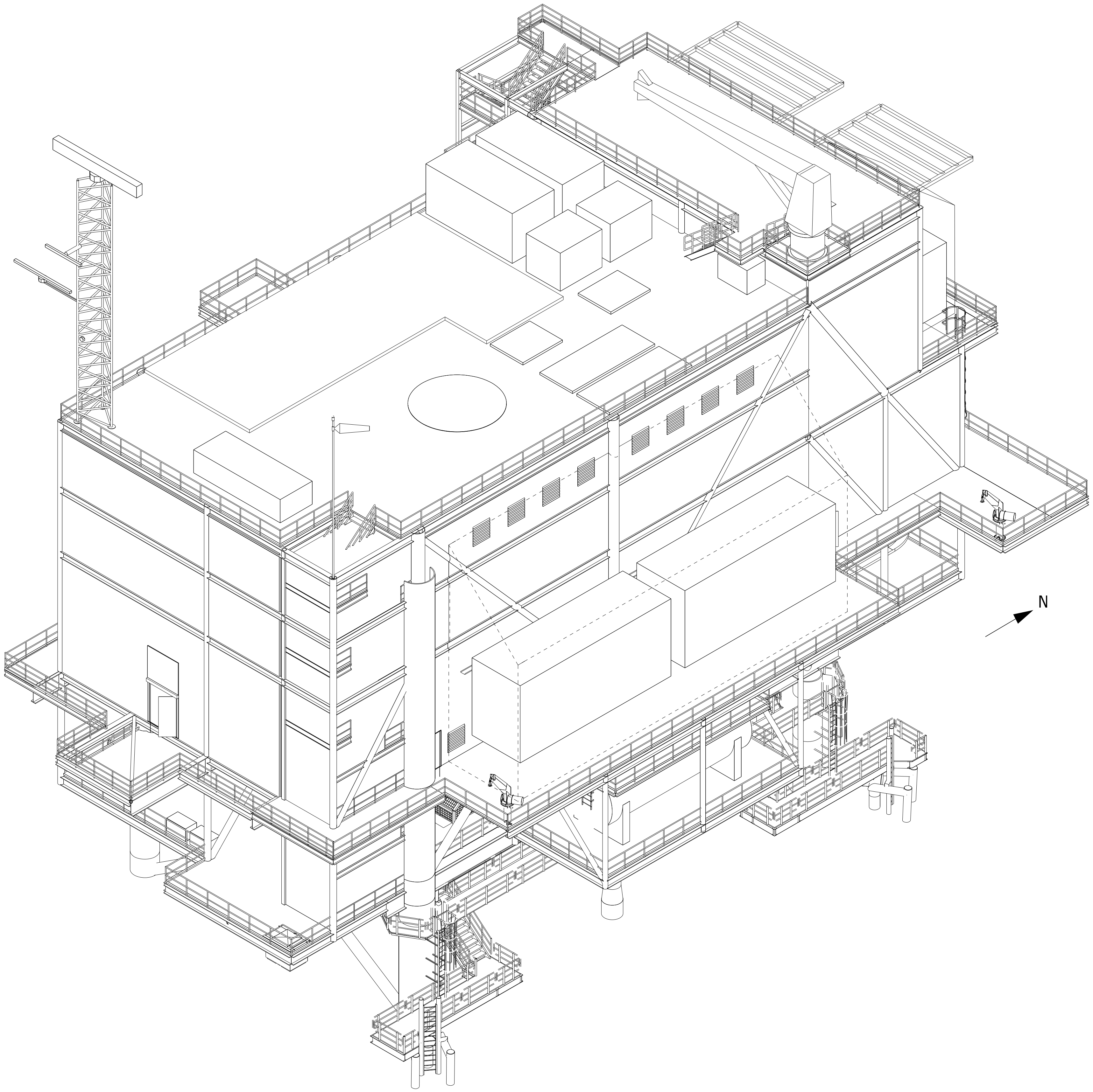

ISOMETRIC VIEW, LOOKING NORTH/WEST

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Job no. 1100015665

STANDARD 700MW AC OFFSHORE SUBSTATION

Title
OFFSHORE GRID NL
PLOT PLAN
ISOMETRIC VIEW, LOOKING NORTH/WEST

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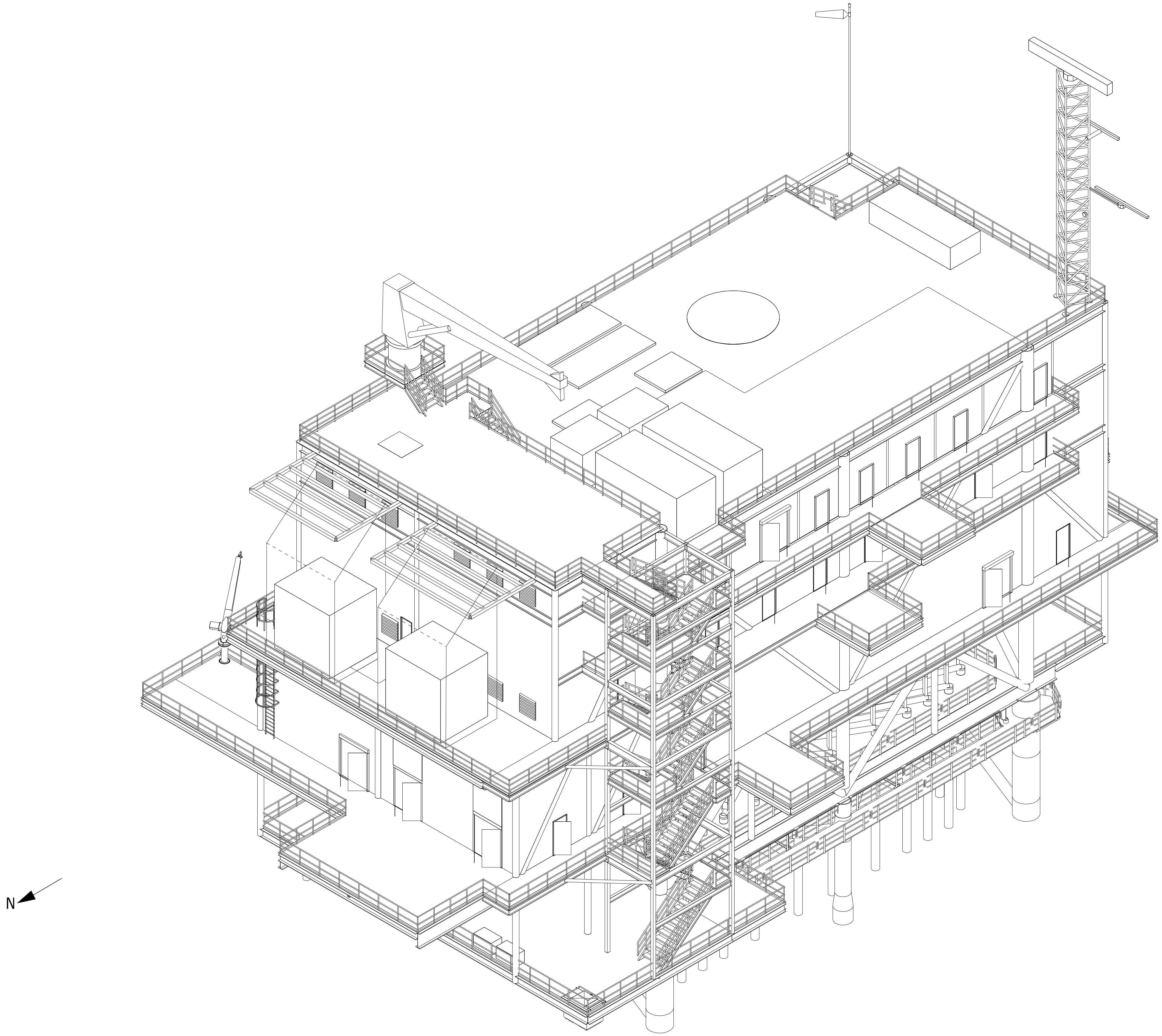

ISOMETRIC VIEW, LOOKING SOUTH/EAST

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RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

OFFSHORE GRID NL

PLOT PLAN

ISOMETRIC VIEW, LOOKING SOUTH/EAST

Scale	Size	Drawing no.	Rev.
NTS	A1	TT-Z-02-013-01	1

II

BIJLAGE: METHOD STATEMENT INSTALLATION HKZ CABLE

PROJECT LEADER	Maarten Dirkes	**DATE**	09-01-17
CLIENT	Licensing team	**VERSION**	0.2
AUTHOR		**PAGE**	1 of 60
DEPARTMENT	AMO-NL		

Method statement installation HKZ cable

Cable design and installation from Maasvlakte 380 kV substation
up to the HKZ Alpha and HKZ Beta platform locations

1. Introduction

1.1 General project introduction

By means of the National Energy Agreement, the Dutch government wants to achieve a substantial increase in the share of wind energy in the Netherlands' energy mix. To increase offshore wind energy capacity, the government has designated three zones in the North Sea for the development of new wind farms.

The offshore wind farms will be connected to the national transmission grid by means of an offshore transmission grid. TenneT has been appointed as operator of the offshore grid by the Ministry of Economic Affairs.

One of the three wind farm zones lies offshore from the coast of The Hague, Zuid Holland and is referred to as the Hollandse Kust (zuid) Wind Farm Site (from here on denoted as HKZ). The wind farm site will be connected to the onshore grid in Maasvlakte. The route from the wind farm site to the onshore grid is show in Figure 1.

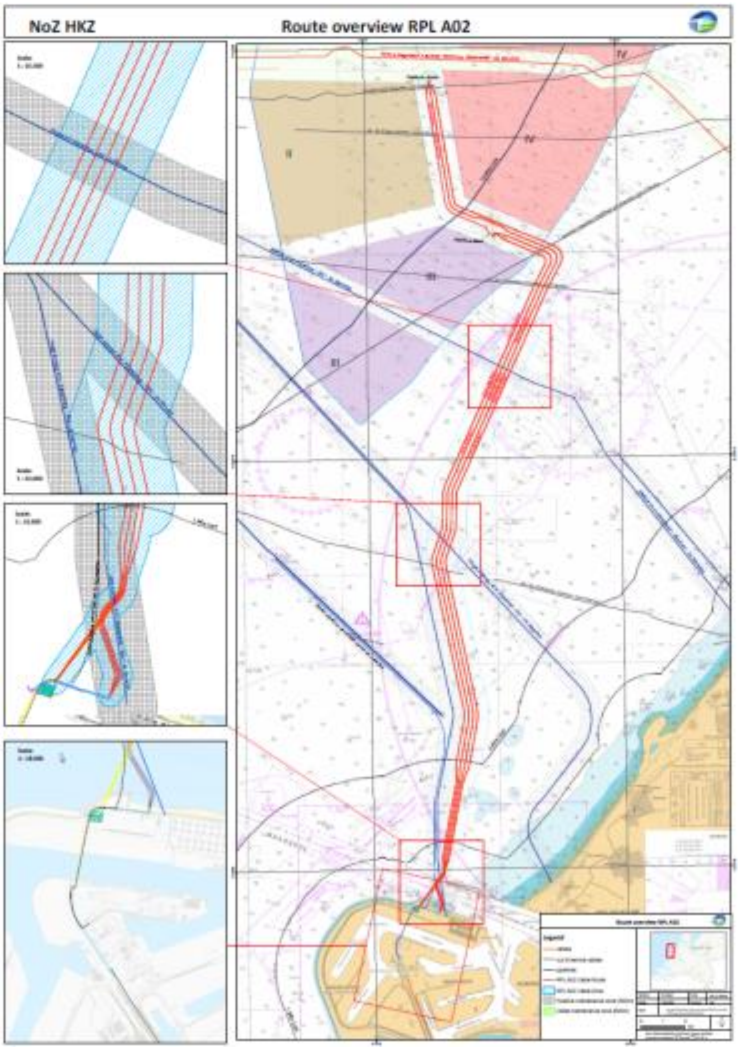

Figure 1 Chart Routeing of the cable from the HKZ windfarm to the onshore grid on Maasvlakte

1.2 Reading guide

This report outlines the method statement for the cable installation of the offshore grid connection of HKZ. The report is made up from the following chapters:

- Chapter two gives a description of the cable route, its different parts and used definitions.
- Chapter three elaborates on the process of the cable installation.
- Chapter four gives an high-over description on the design of the different cables
- Chapter five elaborates on the burial depth of the cables
- Chapter six describes the activities that take place prior to the installation of the cables
- Chapter seven describes the onshore cable route and installation methods
- Chapter eight elaborates on the landfall of the cable and installation methods
- Chapter nine elaborates on the Maasmond crossing and the associated installation methods.
- Chapter ten elaborates on the offshore part of the cable route and the installation methods
- Chapter eleven describes the crossing of 3rd party asset

1.3 Status of the Method Statement

The export cable project will be put on the market by means of publishing an Invitation To Tender. The installation requirements for the project will comprise out of permit driven requirements, technical requirements and functional requirements with regards to the installation. The burial depth of the cables will be imposed by TenneT, taking multiple sources into account. These sources are the requirements from the permits, the Risk Based Burial Depth study, the seabed mobility study and CAPEX/OPEX considerations. Further elaboration of these items is given in chapter 0. As long as the specific installation requirements are met, no specific installation method will be required from the tenderers, it will be left open to the market to propose suitable installation methods. This provides room for the market to propose innovative and potentially cost saving methods. All proposed methods will be assessed taking into account the project specific requirements including the specific site conditions as for instance the soil, wave and weather conditions.

As a result of the open approach of the market this method statement describes a range of installation methods which are expected to be offered by the market. It could however well be that methods deviating from what is described in this method are proposed, for instance using innovative techniques. All tenderers to the project will be requested to prepare a burial assessment study based on the provided soil information for the route at tender as well as to assess the provided metocean data with regards to workability. The cable burial methods proposed by the tenderers are to pass through the soils encountered along the route, whilst taking into account all constrains following from the Water permit and from QHSE requirement.

For licensing purposes a ‘reasonable worst case scenario’ is considered with regards to the environmental impact of the installation. This method statement does describe some foreseeable options for the various sections of the cable. The worst case scenario considered is part of these installation options described.

2. Cable route overview

This chapter gives an overview of the cable route and starts with a description of the different parts of the offshore grid connection in paragraph 2.1. The paragraphs after that elaborate on the different cable sections.

2.1 Offshore grid connection

The offshore grid connection of TenneT consists of six main parts as shown in Figure 2. The items 'A to C' are the connection points in the grid, the items '1 to 3' the cables connecting them and 'i' represents the landfall. The cable route from 'A' to 'i' is the offshore section (this includes the Maasmond crossing, as later on described) and from 'i' to C is the onshore section.

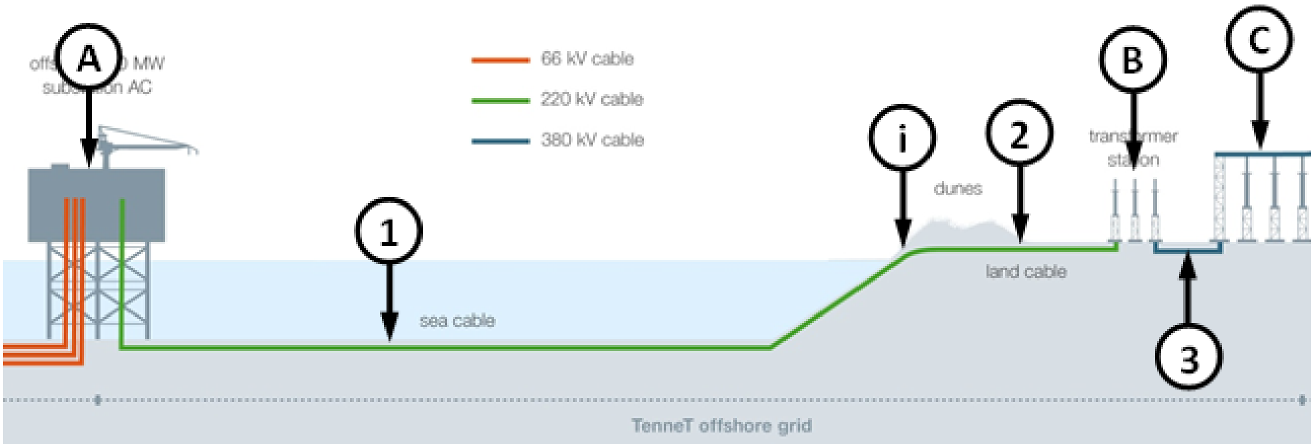

Figure 2 Offshore grid connection

Connection points

A. Offshore platform
   - A1 = HKZ Alpha platform
   - A2 = HKZ Beta platform
B. Maasvlakte land station
C. Maasvlakte 380 kV substation

Cables

1. HVAC 220 kV submarine export cables
   - 1a. Maasmond crossing via HDD
   - 1b. Maasmond crossing via trenching
2. HVAC 220 kV submarine or land export cables
3. HVAC 380 kV onshore cable
   - 3a. HDD crossing of Yangtze canal
   - 3b. HVAC 380 kV onshore cable

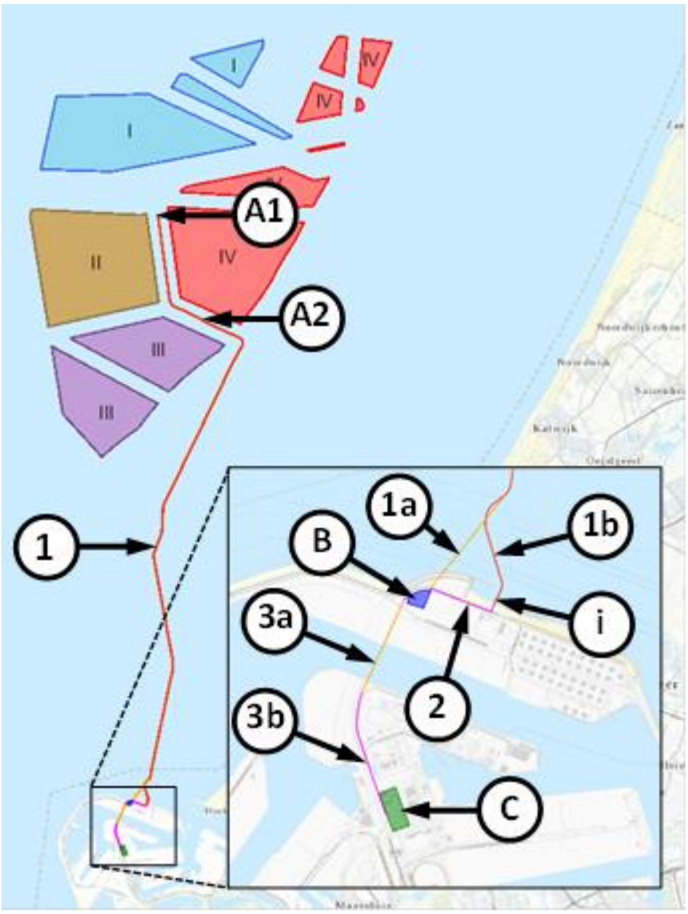

Figure 3 Offshore grid connection HKZ

2.2 HKZ 220 kV export cables

The export cables are connecting the HKZ Alpha and the HKZ Beta platforms to the shore. Two cables run from shore to each platform. The northern of the two is numbered 1 and the southern number 2. From east to west the four cables are labelled Alpha_1, Alpha_2, Beta_1 and Beta_2.
The routeing of the HKZ export cables can be divided in three main sections, where the first section is the onshore section, the second section the crossing of the Maasmond navigational channel and the third the offshore section. For the second section two options are presented; trenching and HDD (Horizontal Directional Drilling or other drilling methods like micro tunnelling etc.). These options will be elaborated on further on in this report.

The *trenching option* results in three distinct sections;

1. Onshore section: HVAC 220 kV submarine or land cables between the HKZ Land Station and the landfall (till LAT -10 m). This includes a possible transition joint;
2. Maasmond section: HVAC 220 kV submarine cables from the landfall, crossing the Maasmond navigational channel and the TAQA pipeline via trenching;
3. Offshore section: HVAC 220 kV submarine cables from the crossing with the TAQA pipeline to the locations of the HKZ Alpha and HKZ Beta platforms. The offshore section can further more be split up into three sections (not reflected in the figure below):
    a. Shallow part off the coast till the LAT – 20 m line. In this part coastal dynamics come into play
    b. Deeper water past the LAT – 20 m line where sand waves aren't present yet
    c. Deeper water past the LAT – 20 m line where sand waves are present

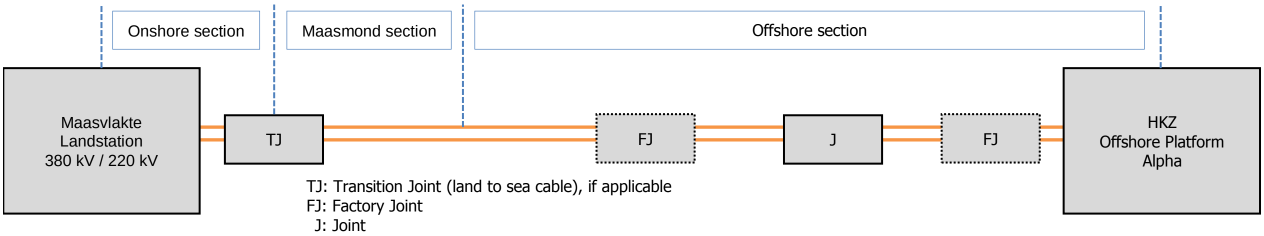

Figure 4 Schematic presentation of the HKZ export cable systems (trenching option)

The *HDD option* results in two sections;

1. HDD section: HVAC 220 kV submarine cables from the HKZ Land Station, crossing both the Maasmond navigational channel and the TAQA pipeline via a HDD over the whole length.
4. Offshore section: HVAC 220 kV submarine cables from the crossing with the TAQA pipeline to the locations of the HKZ Alpha and HKZ Beta platforms. The offshore section can further more be split up into three sections (not reflected in the figure below):
    a. Shallow part off the coast till the LAT – 20 m line. In this part coastal dynamics come into play
    b. Deeper water past the LAT – 20 m line where sand waves aren't present yet
    c. Deeper water past the LAT – 20 m line where sand waves are present

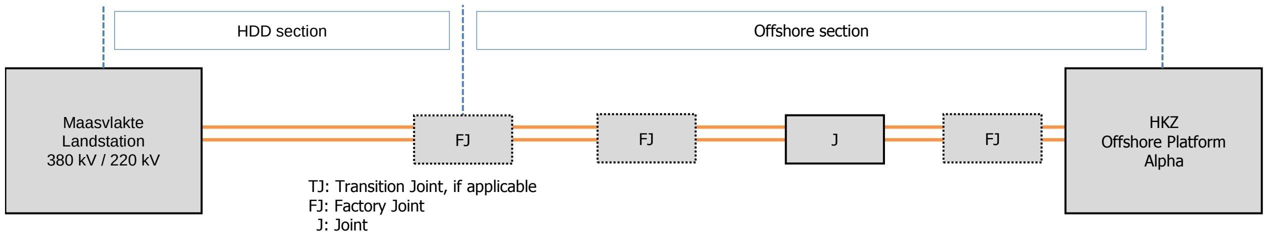

Figure 5 Schematic presentation of the HKZ export cable systems (HDD option)

In between the landfall and the TAQA pipeline crossing the cables are spaced 30 m apart for the trenching option due to the restricted available space. At this particular section the cables have to be installed in between the TAQA pipeline on the eastern side and on the western side the route of the ROAD pipeline and the southern breakwater of the Maasvlakte. Past the TAQA pipeline crossing, towards the platform locations the cables are spaced 200m apart which allows for a more practical space between the cables for potential repair jobs during operation and maintenance.

In case of installation of the cables in HDD's, the cable routes run from the land station location underneath the Maasmond towards the other side of the TAQA crossing.

2.3 Cables connecting to the substation Maasvlakte 380 kV

The Maasvlakte land station will be connected to the 380 kV grid via the Maasvlakte 380 kV substation. Two 380 kV circuits (each consisting of three single core cables) cross the Euromax terminal and the Yangtze canal via a single HDD. From here on out the routeing follows the *Leidingenstraat* (underground infrastructure corridor) to the substation Maasvlakte 380 kV.

2.4 Cable connecting HKZ Alpha to HKZ Beta

After their installation, the HKZ Alpha and the HKZ Beta platforms will be connected to each other for redundancy. The connecting cable will be a 66 kV subsea power cable comprising three 800-1000 mm^2 cores, with an outer diameter of 15 to 20cm. This cable will be buried into the seabed in a similar way as the export cables are buried.

3. Process description

This chapter gives an overview of the total process of the HVAC cable installation for the HKZ offshore grid connection. From the start of the design till the decommissioning of the HVAC cables. It provides high over information about the different steps that are taken.

Initial design

The initial cable route is designed based on expert judgement, operation and maintenance considerations and available bathymetric and sea chart data. The completion of the initial route is the starting signal for three desktop studies;

1. *Risk Based Burial Depth study (RBBD)*: This study assesses the external threats (anchors, fishing nets etc.) on the cable in relation to the shipping density at the cable route while taking the soil conditions into account to give an advise on the burial depth of the cables for the different parts of the route.
2. *Unexploded ordinance (UXO) desktop study*: This study assesses the UXO's and related risks on the cable route and provides necessary input for the UXO survey that will executed prior to the cable installation.
3. *Seabed mobility desktop study*: This study assesses the seabed mobility for the cable route as is to be expected during the lifetime of the cables.

Together with the environmental impact assessment (EIA) and in consultation with the different stakeholders these form the basis for an update of the initial cable route. The geophysical and geotechnical survey campaign will be executed according to this new cable route, to provide data over the entire cable route. This information is essential input for the basic and detailed cable (route) design as well as for an update of the RBBD and seabed mobility study. The later will be extended with a study assessing the future seabed mobility.

Basic design

The cable route will then be updated based on the survey data, the provided studies and consultation with the different stakeholders. This involves (micro-) rerouting within the surveyed corridor around identified obstacles (like wrecks, UXO's), unfavourable soil conditions and sand waves. The rerouting is intended as well to reduce pre sweep (dredging) volumes in the sand waves (more information on this topic can be found in paragraph 6.7). The burial depth of the cables is determined based on the RBBD and seabed mobility studies as well as an internal review on how maintenance costs can be brought to a minimum (CAPEX and OPEX consideration). Chapter 0 elaborates further on this subject.

Preparations of tender documents follow next, which include for example the installation requirements, the basic cable route design and burial requirements. A particular important document is the burial assessment (BAS) in which the soil conditions, burial requirements, risks and burial solutions are assessed. This document will be used for the verification of the suggested execution methods of the tenderers with the aim of risk reduction and to ensure that the required depth of burial will be reached.

Detailed design

The next step is the tender of the cable installation and cable production from where the winning contractor starts with the detailed design of the cable and cable route. The contractor is requested to (micro) reroute if this benefits the design and is within the permitted corridor. The detailed design will be assessed and approved by TenneT.

A general note on the design and installation of the cables; all relevant codes and standards will be taken into account, in particular the ICPC, WSCS-OCE, NEN3650 / 3656 and (applicable) DNV-GL recommendations.

Execution phase
The installation of the cables can take place after the detailed design is completed, necessary permits are acquired and the production of sufficient cable is finished. The preparation activities prior to the cable installation are discussed in chapter **Fout! Verwijzingsbron niet gevonden.**. The installation method for the different cable route sections are discussed in the chapters 7 - 11. After the installation of the cables an as-built survey will be performed to display the reached burial depth of the cables.

Operation phase
The as-built survey will be used to establish the position of the seabed at installation. During the operation phase a bathymetrical survey will be preformed periodically to verify the burial depth of the cables, in accordance with the permit requirements. Crossings with 3rd party assets will be surveyed as well to verify the conditions of the crossing. If storms pass over the area surpassing the design conditions for the landfall, near shore and crossing locations, additional surveys will be considered for the landfall, near shore and crossing locations. Maintenance will only be performed when a survey reveals that a part of the cable is not sufficiently protected. This part will re-protected by burial or rock placement to ensure the protection of the cable.

Decommissioning phase
The cable will be removed after their lifetime where removal is required by permit or beneficial to the environment, taking the impact of cable removal into consideration.

4. Cable design

In this chapter information is provided on the design of the cables to be installed in the onshore and the offshore section. For the 220 kV onshore section two different cable designs are considered at this stage:

1. A specific land cable design as described in paragraph 4.1;
2. The submarine cable design as described in paragraph 4.2.

For the offshore section, the same type of cable is considered as described in paragraph 4.2. The 66 kV cable is described in 4.3. The land 380 kV cable is described in paragraph 4.4.

4.1 HVAC 220 kV land export cable

The HVAC 220 kV land export cable system consist of three single core cables per circuit in a triangular position and thus the HVAC land cable system consists of a total of twelve single core cables. A separate fibre optical cable is part of this cable system, but for cable temperature monitoring, 2 or more optical fibres are positioned under the metallic sheath of at least one phase of the cable system. These cables will have a rated voltage level of 225 kV (highest voltage for equipment Um is 245 kV) and have an extruded XLPE insulation. The outer diameter D_e will be between 100 and 150 mm. The conductor cross section will approximately be between 1,000 and 1,600 mm^2 Al (Aluminium) or Cu (Copper). Other important aspects of the cable are a metallic sheath around the core.
A typical cross section of a HVAC single core land cable is shown in **Fout! Verwijzingsbron niet gevonden.**.

1. *Conductor*
2. *Conductor screen*
3. *Insulation*
4. *Insulation screen*
5. *Bedding*
6. *Metallic sheath*
7. *Outer sheath*

Figure 6 HVAC 220 kV land export cable

4.2 HVAC 220 kV submarine export cable

The HVAC 220 kV submarine export cable system consists of one 3-core cable per circuit. Therefore, the HKZ HVAC submarine cable system consists of four 3-core cables. These cables will have a rated voltage level of 225 kV (highest voltage for equipment Um is 245 kV) and have an extruded XLPE insulation. The outer diameter D_e will be between 250 and 300 mm. The conductor cross section will approximately be between 800 and 1,600 mm^2 Al (Aluminium) or Cu (Copper) depending on the local soil conditions. Other important aspects of the cable is a lead screen for each core and spacers between the cores including two or three fibre optical cable and an outer covering of the three cores consisting of galvanized or stainless steel armouring wires and layer(s) of black polypropylene yarns. A cross section of a HVAC 3-core submarine cable is shown in Figure 7.

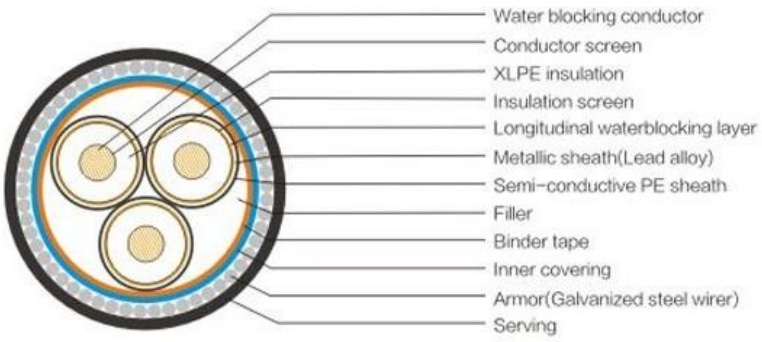

Figure 7 HVAC 220 kV submarine export cable

4.3 HVAC 66 kV redundancy cable

The HVAC 66 kV cable linking the two offshore platforms consists of one 3-core cable. The cable will have a rated voltage level of 66 kV (highest voltage for equipment Um is 72 kV) and have an extruded XLPE insulation. The outer diameter D_e will be between 140 and 170 mm. The conductor cross section will approximately be between 500 and 1,000 mm^2 Al (Aluminium) or Cu (Copper) depending on the local soil conditions. Other important aspects of the cable is a lead screen for each core and spacers between the cores including two or three fibre optical cable and an outer covering of the three cores consisting of galvanized or stainless steel armouring wires and layer(s) of black polypropylene yarns. A cross section of a HVAC 3-core submarine cable is shown in Figure 7.

4.4 HVAC 380 kV land cable

The HVAC land cable system consist of three single core cables per circuit in flat or a triangular position and a total of two circuits and are operated at 380 kV. The total HVAC land cable system consists thus of six single core cables. A separate fibre optical cable is part of this cable system, but for cable temperature monitoring, 2 or more optical fibres are positioned under the metallic sheath of at least one phase of the cable system. These cables will have a rated voltage level of 400 kV (highest voltage for equipment Um is 420 kV) and have an extruded XLPE insulation. The outer diameter D_e will be between 150 and 200 mm. The conductor cross section will approximately be between 1,000 and 2,500 mm^2 Al (Aluminium) or Cu (Copper). Other important aspects of the cable are a lead screen around the core. A cross section of a HVAC single core land cable is shown in Figure 8.

Figure 8 HVAC 380 kV land cable

5. Burial depth at sea

5.1 Burial depth requirements

The 220 kV subsea cables connecting the HKZ Alpha and HKZ Beta platforms to shore and the 66 kV cable between the platform locations will be buried to protect the cables against external threats, in particular fishing, to protect other users of the seabed against hooking behind the cable as well as to reduce the impact on the environment where needed.

There are several perspectives to determine the required Depth of Burial for the HKZ cables:

1. The Depth of Burial as required by licenses, which is considered as an absolute minimum value.
2. The (additional) minimal Depth of Burial as following from the maintenance dredging depth in the Maasmond navigational channel.
3. A Risk Based Burial Depth which will provide a rational minimum to the depth of burial for the various sections of the route based on (statistical) threats to the cable in combination with the protection provided by the local soil types. This would be a rational minimum depth of burial in conjunction with the minimum depth of burial as per licence
4. An economical optimal depth of burial derived from considering the CAPEX installation costs for various installation depths against the OPEX costs of maintenance on the depth of burial over the lifetime of the cable in order to maintain a safe minimum depth of burial.
5. A maximum depth of burial relating to the heating up of cable in relation to the thermal resistivity of the surrounding soils.
6. A minimum depth of burial relating to a maximum allowable seabed heating and the electromagnetic field close to the surface of the seabed, in case such a limitations would be imposed on the cable

From these a minimum maintainable depth and an initial installation depth will be established.

The depth of burial will be defined relative to a reference level. This reference level will either be a threat level determined by assessment of slow seabed mobility (mobility of plates, banks and gullies) or a reference level below the fast moving seabed features as ripples and mega ripples.

5.2 Long term seabed mobility

The cable route passes through areas with mobile seabeds. The changes in depth are part of a process which spans multiple years if not decades. This long term seabed mobility threatens the burial depth of the cable over its lifetime.

It is to be noted that long term seabed mobility cannot be predicted accurately. Any mitigating measure to reduce the risk on cable exposure over its lifetime can therefore never be a guarantee. A prediction will be made based on the observed seabed mobility over the last 30 - 40 years and on state of the art modelling software. A regular route survey along the cable route is required to monitor the development of seabed mobility and its impact on the depth of burial over the cable over its lifetime. Maintenance on the burial depth in the mobile areas cannot be excluded during the lifetime of the cable. The measures to mitigate the impact of long term seabed mobility on the burial depth are therefore to be considered measures to reduce the risk on cable exposure and to minimize and/or postpone maintenance on the depth of burial.

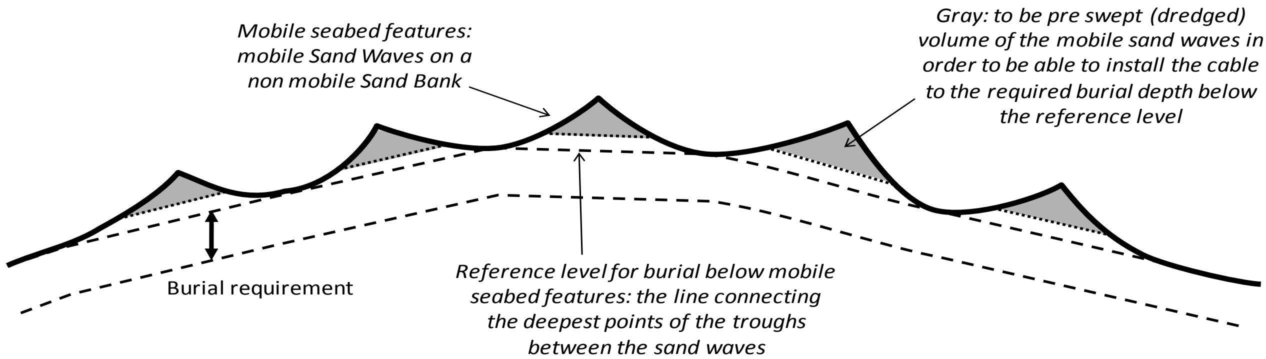

Figure 9 Reference level for cable burial below sand waves

Pre sweeping of a cable installation corridor through areas with mobile sand waves is a proven method to reduce the risk on cable exposure over its lifetime as well as to significantly reduce the amount of maintenance needed on the depth of burial of cables over their lifetime.

5.3 Short term seabed mobility

Along the cable route fast moving mobile seabed undulations are encountered. Of these the so called 'Mega Ripples' are relevant to the burial depth of subsea power cables. Mega Ripples are driven by surface waves. These ripples can be in the order of 0.5 m to 1.5 m in height. Mega Ripples move tens to hundreds of meters per year and come and go depending on the surface waves. Given the height of Mega Ripples, these undulations pose a threat to the burial depth of the HKZ cables. To mitigate this threat, the required burial depth of the HKZ cables is defined relative to a level below these short term seabed undulations, see Figure 10.

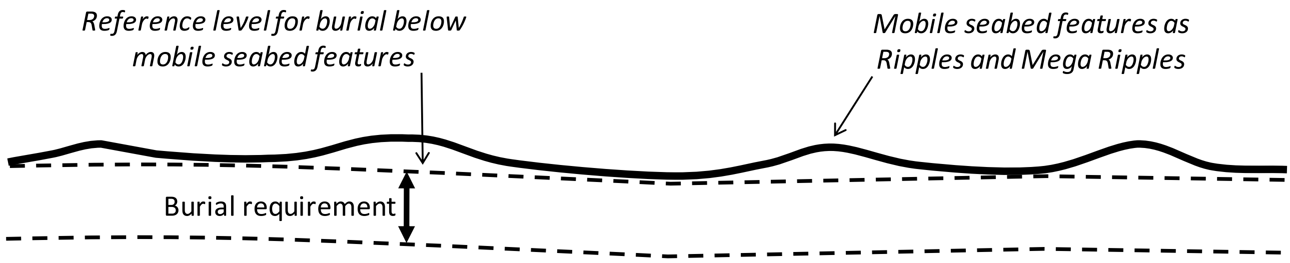

Figure 10 Reference level for cable burial below ripples and mega ripples

There are two options to bury the cable to the required depth below these short term seabed undulations:

1. Flatten the short term seabed undulations prior to cable installation.
2. Install the cable deeper than the initial required burial depth under the short term seabed undulations (provided deeper installation is possible with the applied trencher).

Another reason to flatten higher Mega Ripples is to allow safe passing over of any trenchers which drive over, or are pulled over, the seabed, as trenchers can struggle to pass over these Mega Ripples either because they are too steep or because the trencher digs into the Mega Ripple with its skids or other parts. This depends strongly on the particular cable trencher size in relation to the size of the Mega Ripples.

5.4 Burial depth and cable design

Subsea power cables transmit heat to their immediate surroundings. There is a maximum temperature for subsea cables which is to be respected. The temperature of the cables will be monitored during their operation by the DTS system using a fibre optical cable in the subsea power cable. In case the maximum temperature would be reached, wind turbines will have to be switched off to prevent overheating of the cable and its surrounding.

To maximise the usage of the offshore wind farm capacity, the export cables will be designed such that the maximum cover on the cable during its lifetime, as a result of seabed mobility, does not result in a temperature related constraint for its operation. This implies that cables which will be buried deep at their installation or end up buried deep during their lifetime as a result of seabed mobility, will be designed taking those burial depths into account. Typically this will result in slightly larger conductor diameters or, in more extreme situations, in a copper conductor instead of a more cost efficient aluminium conductor.

6. Installation preparations

This chapter describes the activities that take place prior to the installation of the cables. These are to provide input for the cable installation and to clear and prepare the cable route.

6.1 Initial route survey

Several route options for the export cables for the Hollandse Kust (zuid) have been studied and compares against each other. This comparison has resulted in the selection of the route with a landfall on the Maasvlakte at the Edisonbaai on the south side of the Maasmond.

Early 2017 this route will be surveyed. The bathymetry along the cable routes will be measured in detail and geotechnical and geophysical investigations will be performed to map the seabed in the light of cable burial. Obstacles along the route will be surveyed as well, amongst which the crossings with in service and out of service subsea assets.

The results of the initial route survey will be used for to update route studies well as to prepare the tender documentation.

6.2 Route studies

6.2.1 UXO desk top study

In accordance with the WSCS-OCE requirements an Unexploded Ordnance Desk Top Study has been prepared by REASeuro[1]. Along the routes of the cables unexploded ordnance is to be taken into account.

6.2.2 Risk Based Burial Depth study

One way to compare the different route options for the export cables for Hollandse Kust (zuid) has been to assess the external risks posted to the cables by for instance fishing, dragged and dropped anchors, foundering vessels, lost cargo and alike. This has resulted in initial risk based burial depths for al route options and these depths have assessed when the different route options were compared to each other[2]. This initial risk based burial depth study has been based on already available general knowledge on the expected soil types along the cable routes as well as on a statistical analysis of navigation over the cable routes.

The results of the initial route survey will be used to update the risk based burial depths. Many of the external threats relate to objects penetrating into the seabed, for instance fishing gear and anchors. The initial route survey will provide in depth and detailed insight in the soil types along the cable routes. These soil types, and in particular their resistance against the external threats, will be used to establish a detailed risk based burial depth for all different route sections.

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[1] REASeuro “report RO-160229 Final report DTS HKZ export cable routes version 1.0” dd 19-10-2016.

[2] ACRB RBBD study Q251R1-HKZ RBBD-r0 dd 07-08-16

6.2.3 Seabed mobility study

Another way to compare the different route options for the export cables for Hollandse Kust (zuid) has been to compare seabed mobility along the different routes. In areas with high degree of seabed mobility, the cables will have to be installed deeper and maintenance on the depth of burial over their lifetime is to be taken into account. The information already available on seabed mobility along the different route options including the landfall locations has been assessed in order to compare the route alternatives against each other at an early stage.[3]

The initial route survey will be used to update the initial seabed mobility study for the selected route to the Maasvlakte. Historical data from Rijkswaterstaat will be used to assess changes in the seabed along the cable routes over history. A state of the art mathematical model will be used to assess the changes in the seabed level which are to be expected over the lifetime of the cables. Changes to be expected at the landfall location will be assessed as well as part of this study. Plans of Rijkswaterstaat to mitigate beach erosion at the Edisonbaai are taken into account as well under this study.

The seabed mobility study will be used as input when setting the initial depth of burial of the cables. Within the constraints of the permits and of technology (see 6.5) seabed mobility can be mitigated by deeper initial installation of the cables.

6.2.4 Burial Assessment Study

For successful installation of the cables to the required initial burial depths, a suitable cable burial method is to be selected. The soils along the cable routes in combination with the required burial depths determine which cable burial methods can be suitable. For this purpose a burial assessment study will be prepared for the cable routes, based on the results of the initial route survey. Risk associated with the burial of the cables will be assessed as well as part of the Burial Assessment Study.

As part of their tender contractors bidding on the installation of the Hollandse Kust (zuid) project will have to prepare their own burial assessment study, based on the available soil information from the initial route survey, provided by TenneT, in combination with the specifics of the trenching tools and methods which they are to propose. The burial assessment studies of the contractors will be assessed by TenneT during the tendering process.

6.3 UXO survey

For the clearance of potentially present unexploded ordnance along the routes of the cables, the requirements of the WSCS-OCE (*Werkveldspecifieke certificatieschema voor het Systeemcertificaat Opsporen Conventionele Explosieven*) are being followed, see http://www.explosievenopsporing.nl/dossiers/wscs-oce/

Prior to the route preparation and installation operations an UXO survey will be executed, following the

[3] Deltares report 1221505-000-HYE-0002-r-Seabed mobility study for route comparison Windpark Hollandsche Kust Zuid dd 24-03-2016

recommendations made in the UXO desk top study. Where possible the cables will be rerouted around potential UXO's encountered during this UXO survey. Typically 15 - 25m distance is to be kept between the cable route and an UXO. Precise standoff distances depend on the types of UXO expected and on the trencher that will be used. These distances are prescribed in the UXO desk top study.

The risk on the presence of UXO's along the route cannot be controlled by the installation contractor. For reasons of cost efficiency TenneT will put the UXO survey on the market as a separate project, with TenneT bearing the responsibility of the UXO management. This same approach has proven to be effective in the preparation of the installation of the Borssele cables. The cable installation contractor will be consulted in the process with regards to the specifics of the intended cable installation spread and in particular with regards to the possibilities to avoid potential UXO's by rerouting around those locations.

Potential UXO's which cannot be avoided by rerouting will be investigated by either an ROV (remotely operated vehicle) or by a diver. In case the object is identified as being an UXO, clearance of the UXO by removal or detonation will be performed by specialists from the Royal Dutch Navy. Where required the UXO will be exposed by the UXO survey contractor by removing soil from above it with a dedicated dredge pump.

After the UXO survey and after clearance of potential UXO's which could not be avoided, an ALARP (As Low As Reasonably Possible) will be provided by the UXO manager to the installation contractor for each cable route.

6.4 Route survey

Before installation activities commence, a route survey will be conducted by the installation contractor. The goal of this pre installation survey is to update the bathymetry, to scan the cable route for obstacles, and to update the understanding of the particulars of the cable route in relation to the selected installation methods. A particular focus will be on the mobile seabeds (mega ripples, sand waves, mobile banks), on the shallow grounds and on soil types adverse to the selected trenching method(s) (for instance clay, peat, glacial till in case of jet trenching). For the section in the Maasmond special attention is paid in regards to interference with marine traffic in the navigational channel. All operations in this section will be performed in close communication with the harbour authorities.

6.5 Detailed route engineering

The knowledge of the cable routes and the obstacles along those routes, gathered during the surveys, will be used for detailed route engineering (or “micro rerouting”). Within the boundaries of the permitted corridor for the cables and within the surveyed corridor, a detailed routeing will be engineered for all cable routes. Objective for the route engineering is to reduce the installation risks as well a risks with regards to future maintenance of the cables by avoiding obstacles as for instance potential UXO's and wrecks as well as to reduce seabed preparation by for instance pre sweeping of mobile sand waves. Crossing angels with in service subsea assets to cross, for instance telecom cables and pipelines, will be optimised for installation purposes as well as brought in line with the particulars of the crossing agreements for each crossing.

Rerouting the cables can result in slightly longer cable route lengths, typically in the order of 1% to 2%. The costs of the additional route length will be balanced against the reduction of installation costs and risks as well as against the reduction of cable burial depth maintenance costs.

As part of the detailed route engineering the installation depth of burial of the cables will be set for all route sections. The installation depth of burial will be determined by the largest required installation depth as following from either of these:

1. The requirements in the permits with regards to the installation and maintenance depths
2. The Risk Based Burial Depth, where burial depths to protect the cables against external threats are assessed taking into account an acceptable probability of failure of the cables due to these external threats
3. An assessment of seabed mobility where seabed preparation and deeper initial installation are balanced against the expected costs of maintenance on the depth of burial over the lifetime of the cables (CAPEX vs OPEX)
4. An assessment of the soil types along the cable routes
5. An assessment of known future usage of the seabed along the cable routes which might influence the depth of burial requirements, for instance plans to deepen navigational channels or plans to dump dredged soil.

The installation depth of burial will be set relative to a non mobile reference level, see 0.

The maximum installation depth will be limited by:

1. Permitted maximum dredging volumes
2. Technical possibilities available on the market with regards to cable trenching depths
3. Limitations with regards to installation techniques following from the permits and from the requirements from stakeholders as the harbour authorities.

Limitations with regards to the installation depths relative to the technical optimum installation depth following from the above will result in additional depth of burial maintenance during the lifetime of the cables. The impact of the installation therefore will have to be compared to the impact of maintenance operations during the lifetime.

6.6 Route Clearance

After the pre installation route survey, the route will be cleared of out of service cables and pipelines and any significant debris encountered. Just before the cable installation all objects on or just beneath the seabed on the cable route that may interfere with the installation, are cleared with a pre lay grapnel run. During this operation a shallowly penetrating train of grapnels will be dragged over the centre line of the intended cable routes. In particular abandoned ropes, wires and fishing nets pose a potential obstruction to cable installation. The pre lay grapnel run reduces the risk of obstruction during the trenching operation. All the removed debris will be brought back to the harbour and be deposed off in accordance with applicable regulations.

In case unknown wrecks (not present on current sea-charts) are discovered during the survey or other objects with possible archaeological value, notice will be made and reported to the authorities. Where ever possible these objects will be avoided by rerouting the cables around them.

6.6.1 Pre detected OOS cables: ICPC Recommendation number 01

For the crossings with Out Of Service subsea telecom cables, the ICPC recommendation 01 “Management of Redundant and Out-Of-Service Cables” will be followed. The OOS cable will be dragged from the seabed to deck. A section will be cut out of the OOS cable long enough to clear the route for the HKZ cables. The ends of the cut OOS cable will be placed back on the seabed attached to a clump weight to secure the end of the cable to the seabed.

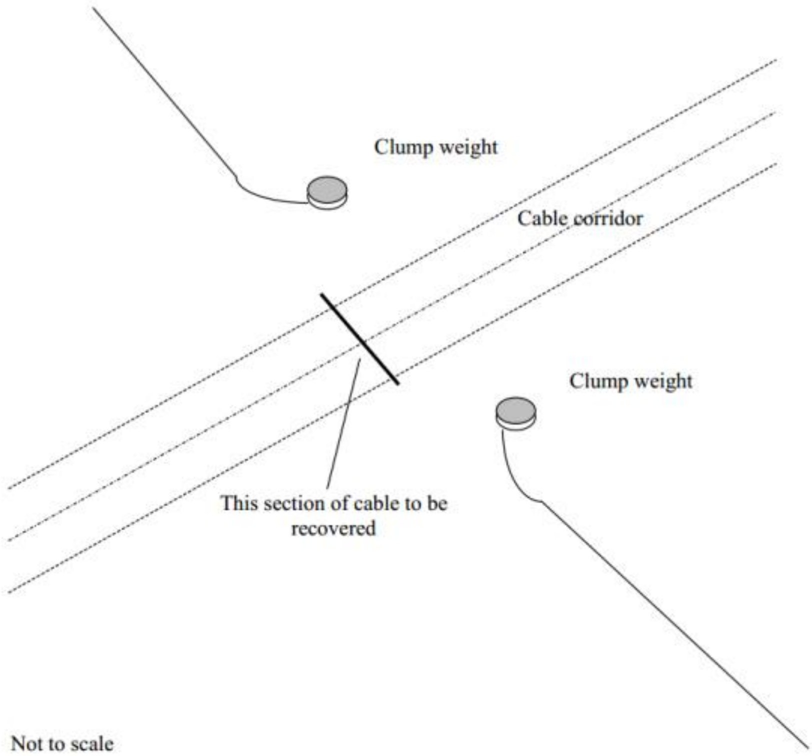

Figure 11 Partial removal of OOS cables cf ICPC recommendation 01

6.6.2 Non pre-detected cables

It cannot be fully excluded that during the installation of the HKZ cables unknown and earlier non detected subsea cables are encountered during the lay and burial operations. In case such a cable would be found, it will be attempted to bury the encountered to a larger depth by jet trenching and to cross with the HKZ cables at the required depth of burial. In case this appears not to be possible, a rock placement will be considered to protect the shallow buried HKZ cables at that location.

6.7 Preparing for burial in areas with mobile seabeds

6.7.1 Minimising dredging by route engineering

As part of the detailed route engineering (see 6.5) the routes for the four individual cables will be assessed in the light of sand wave mobility. By micro rerouting the individual cable routes in these sections, crests of sand waves will be avoided where possible, by rerouting though the troughs between the sand waves. In sections where the cable route lies more or less parallel to the crests of the sand waves rerouting can reduce dredging volumes.

The objective of the route engineering in areas with mobile seabed features is to reduce maintenance on the depth of burial of the cables over their lifetime as well as to reduce the impact on the environment and on other users of the sea during the operation and maintenance phase of the cables.

As a part of the assessments a comparison between the additional installation costs associated with dealing with seabed mobility on the one hand (CAPEX) and the costs involved in the expected future maintenance as a result of seabed mobility on the other hand (OPEX) will be made. Based on earlier projects (NorNed, BritNed, COBRA, Borssele) it is expected that pre sweeping (dredging) mobile seabeds prior to cable installation does reduce the lifetime impact on the environment by the total of cable installation and maintenance as well as reduce the total costs of ownership (TOTEX). In particular with BritNed TenneT has gained experience with the benefits presweeping mobile sand waves prior to cable installation with regards minimising maintenance on the depth of burial of the cables over their lifetime.

6.7.2 Pre sweep (dredge) profile design

Where mobile sand waves are to be crossed, pre sweep (dredging) profiles will be designed through the individual sand waves on a “trough to trough” basis. A corridor will have to be dredged which is wide enough for a cable trencher to pass through. Typically the pre sweep profiles have bottom width of 14m. The side slopes of the pre swept profiles are to be stable between dredging and cable installation.

Where sides of mobile banks are crosses which are retreating along the cable route, dredging profiles will be considered as well to postpone maintenance of the depth of burial.

6.7.3 Pre Sweeping mobile seabeds

Prior to cable installation the mobile seabeds will be pre swept in accordance with the design. The dredging operations will be scheduled as closely preceding the cable lay and trenching operations as practically possible to minimise the impact of natural backfilling of the pre swept profiles between dredging and cable installation. A Trailing Suction Hopper Dredger will be used to pre sweep the mobile seabeds. Only sand will be dredged as any encountered clays or other cohesive material is considered non mobile over the lifetime of the cable. If any cohesive material is encountered during dredging (which has not been detected during the route survey), the dredging in that section will be stopped at that level.

The dredged seabed material will be disposed of gradually and equally besides of the cable route in order to keep the dredged material in the local mobile seabed system. Disposal will be by gradually opening the bottom doors of the hopper while sailing at a low speed along a track adjacent to the cable route. Typically a distance of 200m will be kept to the outer most cable route on the downstream side.

The cables will be trenched in the bottom of the pre swept profiles and therefore the cables will be protected in the pre swept profiles immediately after their installation. The pre swept profiles will be back filled by nature over time. The time required for sand waves to recover depends on the local seabed currents. It typically varies from weeks close to the coast line to years at deeper water where tidal currents are less.

6.8 Pre-trenching run

In case the burial assessment study, based on the soil information available from the initial cable route survey, indicates a relevant risk on not achieving the required depth of burial due to soil conditions, a pre trenching run will be considered. During the pre-trenching run the same trencher but without cable will be pulled along the cable route section selected as is intended to be used for the cable installation. As the cable is not present during that operation and as such is not pressing constrains during the pre-trenching run, the possibilities of using the trencher are slightly wider. Slower pulling and repeating sections becomes possible.

In sections where the pre trenching run appears not successful, pre dredging, pre-cutting or a soil strength related reduction in the burial depth can be considered, depending on the local depth of burial requirements in relation to the permits and the risk based burial depths.

6.9 Pre cutting

Occasionally pre-cutting of the soil along the route can be applied, where soils, adverse to trenching, such as peat, clay or glacial till pockets, are being reckoned with. It is an operation comparable to trenching, which reduces failure to achieve the required burial depth in identified pockets of adverse soils. For pre cutting either a cable plough or a chain cutter trencher can be used.

7. Installation of cables onshore

7.1 Landfall options

The cables can be brought to land either by trenching them across Maasmond up to de beach and install them in an open trench from there on or through horizontally drilled ducts under the Maasmond, see 2.2.

This chapter describes the installation of the cables onshore. A split is made between the onshore 220 kV and the 380 kV cables. The onshore 220 kV section is only applicable for the trenching option since the HDD 'ends' in the Maasvlakte land station.

7.2 Onshore 220 kV cable routeing.

Figure 12 shows the onshore 220 kV export cable routeing between the Maasvlakte land station and the landfall location. This will be either four circuits of submarine (three core cables – see Figure 14) or land cables (single core cables in a HDPE conduit, bundled in triangular position per three single core cables – see Figure 15). The length of the cable connection is approx. 1100m on public land. The cable system will be installed at approx. 1.2 m depth and with an approx. centre to centre distance of 1.4 m per circuit. When the single core land cable will be used, also HDPE conduits will be installed parallel to the cable system to facilitate fibre optics to be installed for communication purposes. Next to the HDPE conduits earth connections could also be installed.

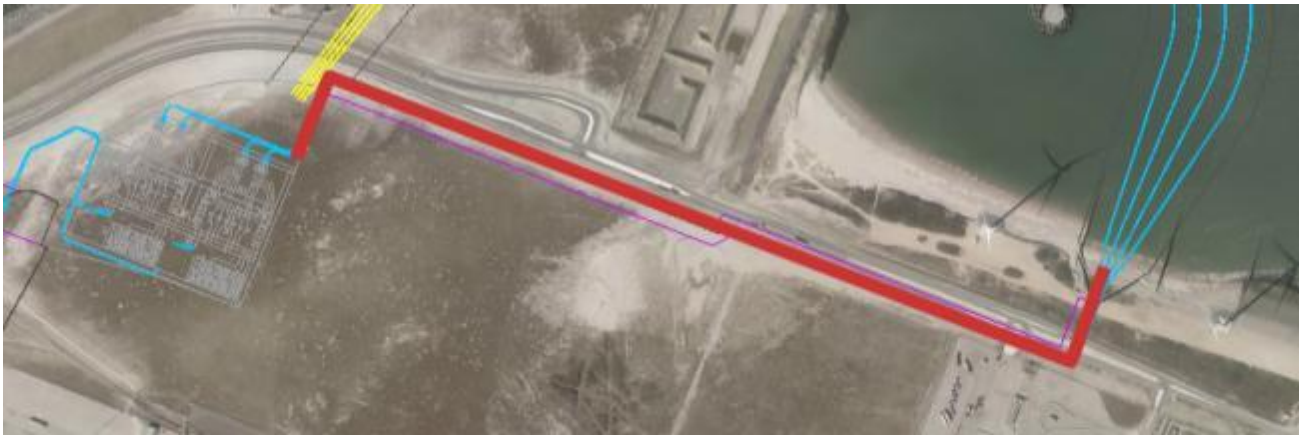

Figure 12 Onshore 220 kV export cable route

Note to the figure above: yellow: the HDD's; blue: cable route for lay and trenching; red: land route 220 kV

7.3 Onshore 380 kV cable routeing

Figure 13 shows the onshore 380 kV cable routeing between the Maasvlakte land station and the Maasvlakte 380 kV substation. Red shows the section of the routeing where open excavation will be used, the yellow section represents the HDD under the Yangtze canal and the Euromax terminal. The cable system consists of two circuit 380 kV circuits, each comprising three single core 380 kV cables in HDPE conduits in triangular position – see Figure 16. The length of the cable connection is approx. 4400m on public land. The cable system will be installed at approx. 1.2 m depth and with an approx. centre to centre distance of 1.4 m per circuit. Additional HDPE conduits will be installed parallel to the cable system to facilitate fibre optics to be installed for communication purposes. Next to the HDPE conduits earth connections could also be installed.

7.3.1 Yangtze HDD

The HDD under the Yangtze canal and the Euromax terminal consists of a single drilling with an approximate length of 1200-1300 m and an approximate maximum depth of 42 m below NAP (Dutch reference level). The expected diameter of the boring is Ø 1320 mm and Ø 1000 mm for the steel conduit. Each of the six 380 kV land cables will be placed in a PE conduit within the steel conduit. This information is based on the information available at this stage of the project. Changes to these numbers can occur during the detailed design. Also the type of installation method can change since there are also other drilling methods like the Direct Pipe®, micro tunnelling etc. available on the market to realise this drilling. The Horizontal Directional Drilling is however deemed most likely to be performed and therefore only this option is further elaborated (see paragraph 9.2).

Figure 13 Onshore 380 kV cable route

7.4 Cable trench design

Below the three different cable and trench configurations are given:

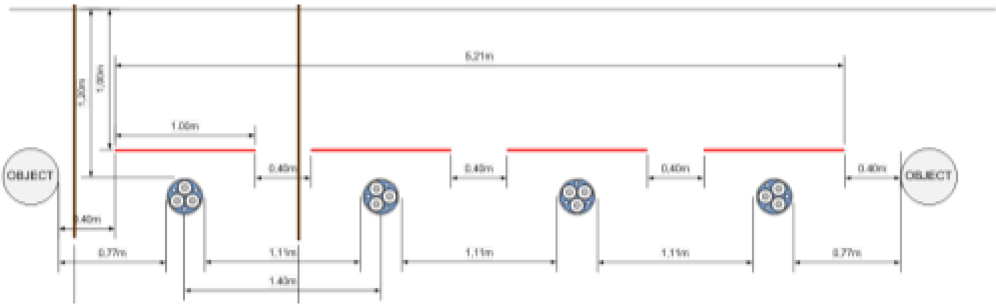

Figure 14 Trench cross section - 220 kV submarine export cable

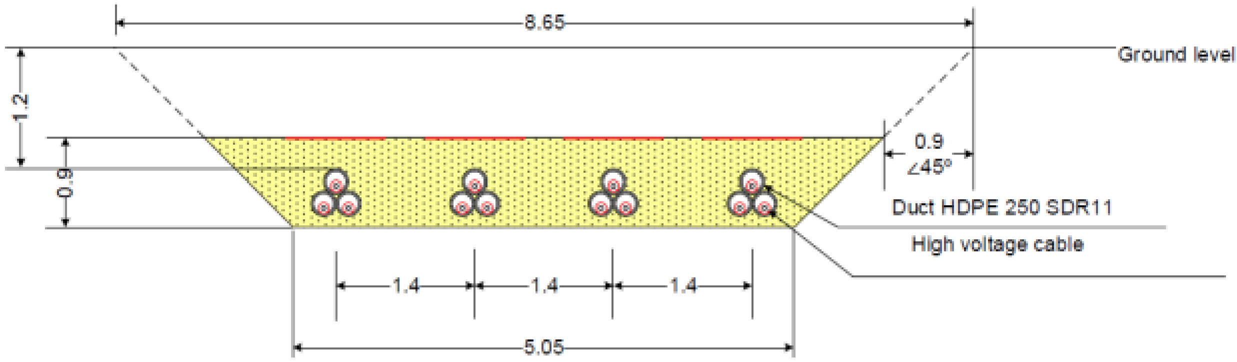

Figure 15 Trench cross section - 220 kV land export cable

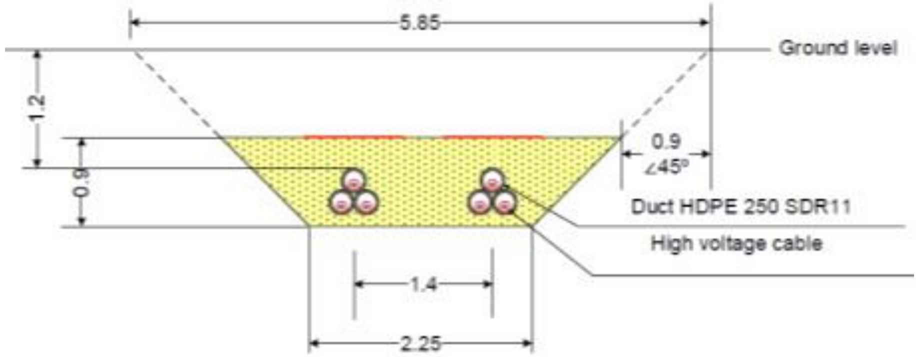

Figure 16 Trench cross section - 380 kV land cable

A trench of the required depth and width is dug and if necessary, rainwater and/or groundwater will be pumped out of the trench and discharged on surface water in the direct vicinity. All soil types are stored separately next to the trench. The area on the other side of the trench is used to move heavy equipment, where necessary the soil and/or road is protected with metal or wooden protection mats. The typical width of a working area is 20 m.

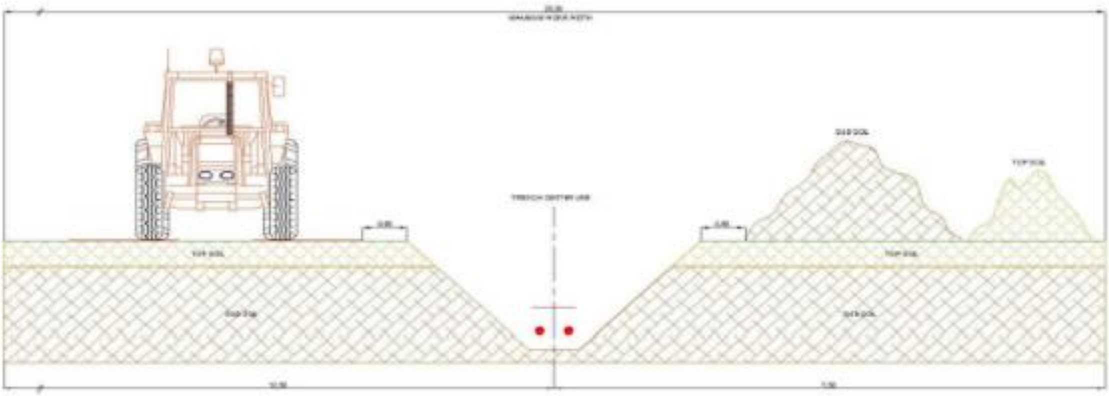

Figure 17 Separate handling of soils excavated from the trench

7.5 Land Cable installation

The cables are pulled in using rollers, cable tensioners and winches. The cables will be laid on a bed of stone free backfill sand. The cables will have a further cover of approximately 200 mm of the same sand and a layer of protection tiles (often red with a warning text). The trench will be closed directly after the installation of the cables using the original soil stored in layers next to the trench. Any surplus soil will be spread evenly in the working area allowing for some future compacting of the soil. The compaction will ensure stable ground and to prevent any subsidence of the soil at ground level. During the backfilling a warning tape will be installed above the protection tiles.

The installation works will take approx. 2 to 4 weeks to complete for each cable circuit, weather permitting. If the submarine cable will also be used for the land section, each cable circuit (which consists of one three core submarine cable) will be installed separately with at least some weeks between the installation of the first and second cable.

Figure 18 Pull in wire and rollers (left), backfilling before cable pull in (middle), typical roller (right)

Figure 19 Typical cable tensioners

Figure 20 Typical cable winch

8. Landfall

This chapter describes the landfall of the four HVAC 220 kV submarine cables at Maasvlakte 2. This is only applicable for the option where the crossing of the Maasmond is realised via trenching. The HDD 'lands' after all on the Maasvlakte land station. For this section use has been made of the memo *Landfall at Maasvlakte 2* (Primo Marine, J. Smit – 2016).

8.1 Site description

The landfall is shown in Figure 21. This location is adjacent to the Maasmond and is called the Edisonbay. The landfall is in between two wooden breakwaters. The beach at this location comprises of sand covered by gravel/pebbles.

Figure 21 Landing site at the Edisonbay

8.2 Cable installation at the landfall

Two different scenarios have been distinguished for the cable installation at the landfall; a scenario with a cofferdam and a scenario without a cofferdam (see Figure 22).

Figure 22 Landfall using a cofferdam [courtesy: Voorbij B.V.]

8.2.1 Cable installation with a cofferdam present

Prior to the start of the cable installation the cofferdam will be installed by driving sheet piles into the soil and installing braces. After completion of the cofferdam the soil inside the cofferdam will be excavated with land based excavators. The beach at the Edisonbay is prone to erosion during storm conditions. The installation depth of the cables in the cofferdam will take the mobility of the beach in the Edisonbay into account. The cable lay vessel (CLV) will likely position itself near the southern Hoek of Holland breakwater. The exact location / standoff distance (distance between the vessel and the landfall) greatly depends on the actual (minimum) water depth, the vessel draught and weather and tidal conditions as well as on safety with regards to navigation in the Maasmond. As the vessel has set up at the “start up” location the cable will be pulled in from the CLV to the beach using the pull in winch on the shore. Dedicated communication links will be established between the vessel and the installation team onshore. In order to avoid seabed friction, floatation is attached to the cable (see Figure 23).

Figure 23 Attaching of floatation on the cable

The cable will be pulled into the cofferdam. Upon successful completion of the pull in operation the cable end will be secured and the cable will be lowered to the seabed (surface lay). After the cable has been pulled into the pre-excavated trench in between the cofferdam, it is then already at the required depth (or almost and a trencher is required to get the cable further to its required depth). A trencher will be positioned in the cofferdam or at the seaward side of the cofferdam and the post lay burial of the cable can commence.

8.2.2 Cable installation without a cofferdam

For this scenario the same cable pull-in method is used as described for the scenario with cofferdam; the cable will be pulled in onto the shore from the CLV to the landfall with a winch that is located onshore. The cable will then be lowered onto the seabed. Post lay burial of the cable will commence by positioning a trencher over the cable on the beach and then gradually deepen the cable to the required trenching depth. This method can only be used if the required trenching depth can be sufficient to meet the local requirements with regards to the expected beach erosion without a pre excavated trench. Quite likely this method for deep trenching will require installation operations using a pulling anchor and a pulling wire.

8.2.3 Simultaneous lay and burial

Instead of surface lay and post lay burial (burying the cable to the required depth after it's been placed on the seabed floor) there is an alternative, which is simultaneous lay and burial (laying and burying the cable at the same time). In the simultaneous lay and burial "mode" the speed of the lay operation is dictated by the burial operation, which is far slower than the lay operation. Simultaneous lay and burial is relatively slower then laying only, but for simultaneous lay and burial the Maasmond has to be crossed only once per cable, where post lay burial will require crossing for the lay operations and for the burial operations.

A method for simultaneous lay and burial which will overcome significant installation issues in one passage is installation of the cable by a Vertical Injector or another deep trenching tool from a vessel on DP. With a vertical injector or other deep trenching tool the cables can be installed up to 10m deep into the seabed. This takes away all requirements for dredging preceding the trenching. Downside of this method is however that one pulling anchor is required, which will hamper navigation.

8.3 Attention points

In respect to the landfall and the associated cable installation there are a number of important attention points.

8.3.1 High marine traffic density

With the Maasmond navigational channel adjacent to the landfall, taking the high marine traffic density in the navigational channel into account is of utmost importance. Any activity and especially marine related activities shall be discussed with RWS and the harbour authorities to reach agreement on these activities.

8.3.2 Seabed mobility landfall

The landfall area (Edisonbay) is subject to sediment deposition after storms in the North Sea. This means that the seabed in the Edisonbay is mobile, requiring sufficient burial depth to prevent exposure of the cables and ensure the stability of the landfall. This will be achieved by burying the cables well below the mobile reference level of the seabed and close alignment with RWS on this subject.

8.3.3 Burial challenges

As stated in the previous point, sufficient burial depth is required. At this stage of the project this corresponds to a depth of burial of over 3 meters below the present seabed. This poses challenges for the scenario without cofferdam where this depth of burial has to be reached in one pass with the trencher. Pre dredging in the Maasmond for each cable route will be required to reach the burial depths of over 3 meter, unless a Vertical Injector or other deep trenching tool using a pull anchor can be used.

The top layer of gravel/pebbles on the landfall increases this challenge. There are however several options to bury the cables at this section, of which the most likely methods are for instance a Sea Stallion or Heavy Duty cable plough of VBMS and wheel trenchers as the TM04 of Travocean. These are able to start on the beach, being fed with water via hoses and power through an umbilical from the support vessel. Another option is bury the cables with a trencher in a pre-dredged trench. The trench is filled up again afterwards.

Figure 24 TM04 Wheel cutter cable trencher

Figure 25 Sea Stallion cable plough

8.4 Jointing Pit

After the land fall the HVAC 220 kV cables continue to the Maasvlakte land station via either 220 kV land cable or 220 kV submarine cable. With the option to use the offshore cable for the complete onshore section, the cable will be pulled in from the vessel to the cable terminations of the Maasvlakte land station. The following part on jointing pits is therefore only applicable for the 220 kV land cable option.

The 220 kV land cables and the offshore 220 kV submarine cables will be joined in four jointing pits. After the joints have been made, the space above the pits will be restored in its original state. The jointing area dimensions will be approx. 40 meters in width by 80 meters in length while each of the four jointing pits itself will be approx. 4 meters in width by 20 meters in length. Figure 26 shows a typical layout of a jointing pit.

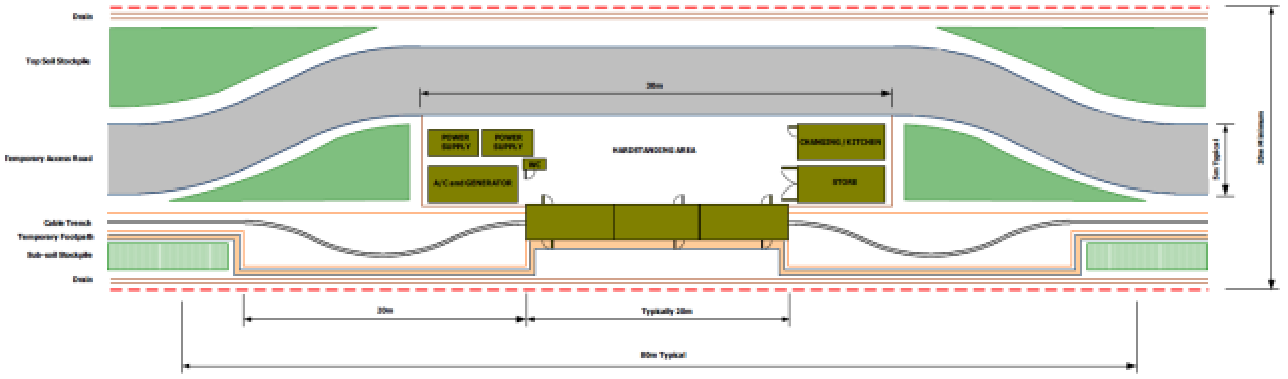

Figure 26 Plan view of typical jointing pit

During jointing operations the jointing position will be covered by a series of specialist containers equipped for the purpose and having such dimensions to fit either into the excavated jointing area or in very wet areas placed over a fully supported trench with the cables being brought up into the containers above the water/flood level. The joints are installed on top a concrete foundation.

The installation and jointing works will take approx. 1 to 3 weeks to complete for each of the four cables, weather permitting.

Figure 27 (left) Cable ends in jointing pit – (right) Typical jointing containers

9. Maasmond crossing

This chapter elaborates on the crossing of the Maasmond, the entrance to the port of Rotterdam. Two different crossing options: trenching and installation in HDD's and their installation methods are discussed.

9.1 Site description

The crossing of the Maasmond is shown in Figure 28. The blue lines represent the trenching option and yellow the HDD option. The trenching continues from the landfall and runs east of the TAQA pipeline. This pipeline will be crossed after the northern Hoek van Holland breakwater. The routeing of the planned ROAD pipeline runs west of the trenching route. The HDD starting point (entry point) is on the Maasvlakte land station and is drilled under the seawall, under the ROAD pipeline route, under the TAQA pipeline and exits east of the TAQA pipeline.

Figure 28 Maasmond crossing

9.2 HDD option

This paragraph describes the installation method of a HDD. There are also other drilling methods like Direct Pipe®, micro tunnelling etc. available on the market to realise the drilling under the Maasmond. The Horizontal Directional Drilling is however deemed most likely to be performed and therefore only this option is further elaborated.

The HDD consists out of four individual drillings, one for each of the four 220 kV submarine cables, with each an approximate length of 1700-1800 m and an approximate maximum depth of 45 m below NAP (Dutch reference level). The expected diameter of the boring is Ø 740 mm and Ø 560 mm for the PE conduit. This is based on the information available at this stage of the project. Changes to these numbers can occur during the detailed design.

The HDD will pass underneath the sea wall on the Maasmond side of the Maasvlakte. This sea wall is not a primary sea defence, the primary sea defence lays more land inward.

9.2.1 General HDD installation stages

A HDD generally consists of three installation stages:

1. First, a drill bit is pushed through the ground on a designed alignment from an entry point close to the drill rig to an exit point on the other side of the obstacle to be crossed. This is called the pilot drilling. Established surveying and steering techniques are used and proven drill tools are available for a wide range of soil and rock conditions.

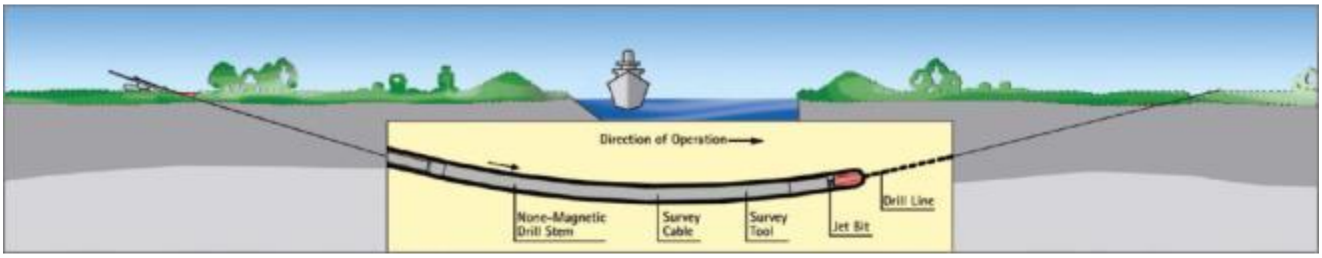

Figure 29 First stage of a HDD - pilot drill

2. The pilot drilling is then enlarged by one or more reaming passes until it has reached the desired diameter. For this purpose, suitable tools like barrel reamers, fly cutters or hole openers are used. During the process, drill pipes are continuously added behind the reamer to ensure that there is an entire drill string from the entry to the exit point at all times. Depending on the soil conditions, a mixture of water and bentonite or other additives can be used for hydraulic excavation. This both supports the bore hole and reduces frictional forces, while allowing the excavated material to be transported to a separation plant on the surface.

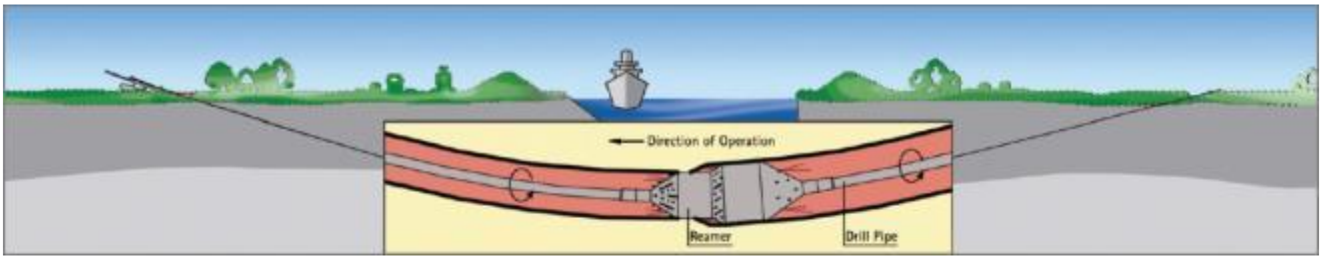

Figure 30 Second stage of a HDD – reaming the pilot drill

3. In the final step of the operation the liner pipe is pulled into the reamed borehole starting at the exit point on the other side of the obstacle. The drill string in the borehole is connected to the pipe by a special pull head with a swivel. As soon as the drill rig has pulled the whole pipeline into the ground and the pull head arrives at the entry point, the pipeline has reached its final and safe position deep in the ground.

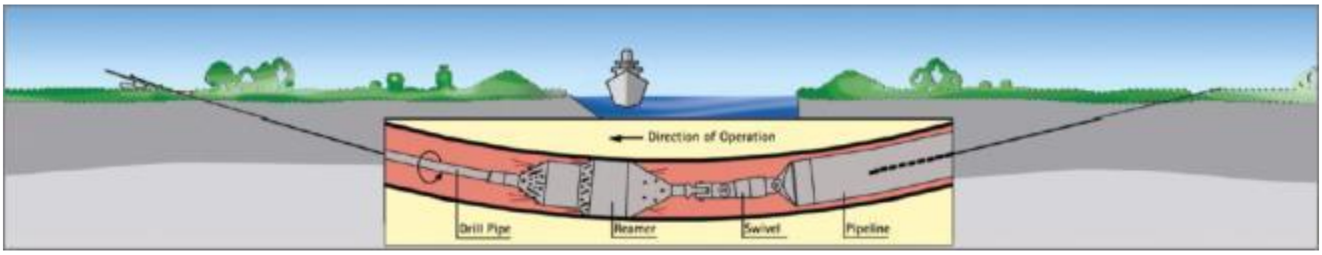

Figure 31 Third stage of a HDD – pulling of the pipeline

Text and figures in this paragraph (9.2.1) are courtesy of wiki.iploca.com

9.2.2 HDD installation specifics

The previous paragraph provided a general approach for HDDs. There are different approaches possible for the Maasmond HDD. These are split up per drilling stage.

All four HDD's will be drilled in one season. The ends of the HDD's at sea will be flanged off and secured at the seabed.

Stage 1 - pilot drilling / meet in the middle

1. Entry / starting point of the pilot drilling is onshore (on the Maasvlakte land station), thus the direction of operation is *onshore → offshore*
2. Entry / starting point of the pilot drilling is offshore (from a jack-up barge), thus the direction of operation is *offshore → onshore*
3. Meet in the middle: drilling from both sides (onshore and offshore) to the middle, thus the direction of operation is *onshore* → | ← *offshore*. One drill head is then being pushed further, following the retracting other head.

As an alternative to the meet in the middle it is possible as well to drill from land all the way to the other side, north of the Maasmond. At that location a dedicated barge will be positioned to receive the drill head. For the section between the exit point and the barge, the drill head will be guided through a pipe. This pipe will be used as well to pump the bentonite from the hole to the barge.

Two HDD's will be drilled simultaneously.

Stage 2 – reaming the pilot drill

1. Reaming starts onshore, thus the direction of operation is *onshore → offshore*
2. Reaming starts offshore, thus the direction of operation is *offshore → onshore*

Bentonite will be pumped from land to sea though the hole which is being reamed. On the sea side the bentonite will be pumped from the exit point through a pipe to the barge and then through another pipe back into the other HDD hole and back to the treatment plant on land. After the first HDD had been reamed, the second will be reamed during which the first HDD hole will be used a bentonite retour line.

Stage 3 – pulling of the PE conduit

Before pulling of the PE conduit commences two reamed drillings ought to be finished. This since one reamed drilling is used as the mud return line while the PE conduit is pulled through the other reamed drilling.

1. The PE conduit is fed onshore (from a reel) into the reamed drilling, thus the direction of operation is *onshore → offshore*.
2. The PE conduit is fed offshore into the reamed drilling, thus the direction of operation is *offshore → onshore*.

Stage 4 – pull-in of the 220 kV submarine cable

Prior to pulling in of a cable the end of the applicable HDD will be retrieved to a barge as that position. The HDD will first be cleaned of any debris or sediments by blowing a special pig though the HDD. A pull in wire will be pulled from land to sea through the HDD.

1. Pulling the 220 kV submarine cable from the cable laying vessel to shore, thus the direction of operation is *offshore → onshore*. The cable lay vessel is located outside of the navigational channel. This will not require an additional joint.
2. Pulling the 220 kV submarine cable from the Maasvlakte land station to a jack-up barge at the end of the PE conduit, thus the direction of operation is *onshore → offshore*. This will require a joint close to the end of the HDD at sea.

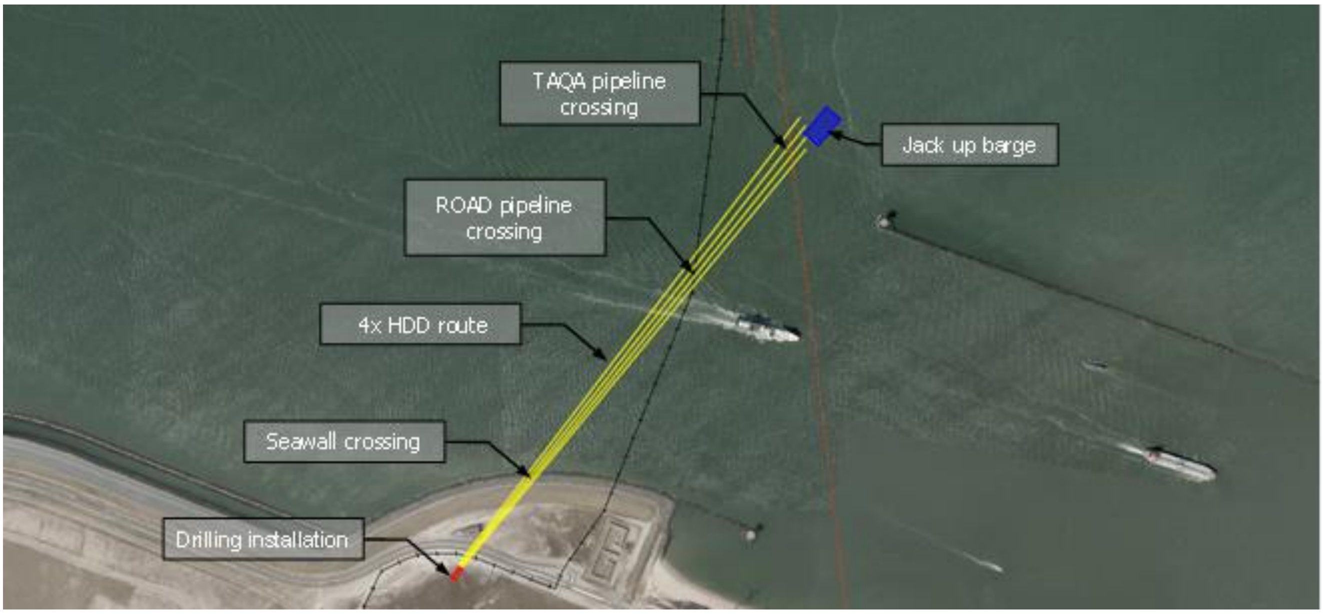

Figure 32 HDD installation

Figure 33 (left) Drilling installation - (right) Jack up barge with a drilling installation

9.2.3 Crossings

The route of the HDD crosses the seawall of the Maasvlakte, the future ROAD pipeline and the present TAQA pipeline. Although the drillings cross these (future) objects at great depth and no there is no physical crossing, close alignment with the responsible parties of these objects is of great importance and has already been initiated.

This means that during the preparations, installation, operation and removal of the HDDs;

1. The stability of the seawall is guaranteed. Stability calculations will be performed and any required actions resulting from the study will be carried out to guarantee this.
2. No harmful interference with the future ROAD pipeline is guaranteed. An interference study will be performed and any required actions resulting from the study will be carried out to guarantee this.
3. No harmful interference with the TAQA pipeline is guaranteed. An interference study will be performed and any required actions resulting from the study will be carried out to guarantee this.

9.2.4 Repairs

It is highly unlikely that a cable installed in an HDD gets damaged after the installation and during its lifetime. In the rare case of a repair of one of the cables in the PE conduits the following approach will be used. An important side note is that the repair will not take place in the Maasmond to prevent any interference with the marine traffic in the Maasmond.

1. The first approach is to cut the cable at the end of the HDD (seaside) and disconnect it from the cable end connector at the Maasvlakte land station. The next step is to pull the broken cable out of the PE conduit over the full length. Water jets similar to those used to clean a sewer can be used to clean the HDD around the cable. After the PE conduit is cleaned (using a method called *pigging*), a new cable will be pulled through the PE conduit. It's then jointed (offshore) to the submarine cable and connected to the Maasvlakte land station. The offshore jointing takes place outside of the Maasmond.

2. If, in the unlikely case it's not possible to remove the broken cable from the PE conduit, a new HDD will be needed. The HDD will be performed as described in paragraph 9.2.2. The old cable will be disconnected and cut at the end of the HDD (seaside). The PE conduit will be cut back at a depth so that is ensured that it's no longer posing any risks. After the HDD is complete a new cable will be pulled through the PE conduit. It's then jointed (offshore) to the submarine cable and connected to the Maasvlakte land station. The offshore jointing takes place outside of the Maasmond.

9.3 Trenching option

The trenching option consists of the laying and burying of four 220 kV submarine cables in the Maasmond over an approximate length of 1,8 km (landfall until TAQA crossing) each in between the TAQA and future ROAD pipeline as seen in Figure 28. After the landfall the cables spread out to a centre to centre distance of 30 meter which is held until the TAQA pipeline is crossed just after the northern Hoek van Holland breakwater. From there on the distance is gradually increased to 200 meter.

9.3.1 Maasmond navigational channel

In contrary to the HDD option which induces little to no interference with marine traffic in the Maasmond navigational channel, the trenching option will induce interference with marine traffic. All activities will be closely aligned with the harbour authorities.

9.3.2 Installation method

To install the four 220 kV submarine cables at the required burial depth which takes the maintenance dredging of the navigational channel into account, either a trencher with a deep installation depth will have to be used or the cable will have to be installed in a pre-dredged corridor. The burial depth and dredging tolerances are still to be determined in consultation with RWS and the harbour authorities. In case of only trenching, the installation will executed using for example a Vertical Injector or other deep trenching tool (more details on this trencher are given in the next chapter). This however requires a vessel or barge working on anchors to facilitate the required pulling force. The harbour authorities have stated that working on multiple anchors in the Maasmond navigational channel is not permitted as it is considered to pose a significant risk on prolonged hindrance to shipping in the busy Maasmond area if something goes different than planned.

A variation on working on multiple anchors is working with deep penetrating jet trencher from a vessel on DP with a single anchor. This option has recently appeared during a market consultation. It has not been discussed with the authorities and not with Prot of Rotterdam yet.

Working with a vessel without anchors and using only dynamic positioning[4] (DP) is possible with a jet trencher. This type of trencher is however not capable of burying the cables to sufficient depth in de Maasmond and thus pre-dredging would be required. This results in the following working order:

1. Pre-dredging a trench till the lowest maintenance dredging level

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[4] Dynamic positioning (DP) is a computer-controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters

2. Laying and burying the cable to the required depth in the pre-dredged trench using a jet trencher and a vessel on DP.

For both options Simultaneous Lay and Burial (SLB) and Post Lay Burial (PLB) are possible installation methods. The next chapter provides more details on these methods. The important difference with regards to the Maasmond crossing is the laying speed versus the number of crossings. For the SLB only one crossing per cable is required at approx 250m/hr while for the PLB two crossing are required; one at approx 500m/hr for the laying of the cable and one at approx 250m/hr for the burying of the cable.

9.3.3 Crossing

The four 220 kV submarine cables will cross the TAQA pipeline just east of the northern Hoek van Holland breakwater. The crossing method is described later on in this report. Important to mention is that there will be alignment with the TAQA pipeline owner to guarantee that there will be no harmful interference with the TAQA pipeline. An interference study will be performed and any required actions resulting from the study will be carried out to guarantee this.

Since the TAQA and future ROAD pipeline are in close vicinity of the cable route in the Maasmond, there will be alignment on this part of the route with the owners of both pipelines to ensure that there will be no damage or hindering.

9.3.4 Repairs

In case of a cable failure in the Maasmond navigational channel the following approach will be used

1. The first approach is to cut the cable at both ends of outside of the Maasmond navigational channel. The next step is retrieving the cable using a special jetting device for removing cables. The new length of cable will then be installed by first pre-dredging a trench and secondly laying and burying the cable using a jet trencher. It's then jointed on both ends. The offshore jointing takes place outside of the Maasmond navigational channel.
2. In case the broken cable cannot be removed, it will be cut at depth so that is ensured that it's no longer posing any. The new length of cable will then be installed and connected in the same fashion as the first approach, only next to the old cable route.

9.4 Considerations

In this chapter the two options to cross the Maasmond navigational channel have been discussed. The decision for either of the two options will be made during the tender phase of the project. The tenders will have to price in both options and the risks related to the execution of both methods. Besides input from the tenders, alignment with the relevant authorities and stakeholders are input for this decision. This paragraph will state high over the pros and cons for either option and the items that will partake in the decision making.

9.4.1 Considered items

Amongst others, the following items are taken into consideration:

1. Interference with marine traffic and the port of Rotterdam
2. Installation risks
3. Technical feasibility
4. Total costs of ownership (CAPEX & OPEX)
5. Schedule risks
6. Operation and maintenance risks
7. Decommissioning

9.4.2 Pro's and con's

The pro's and con's for both the trenching and HDD option are stated in the table below, based on the previously mentioned items.

Item	Trenching	HDD
Interference with shipping	- -	++
Installation risks	-	o
Technical feasibility	+	-
Installation costs	+	- -
Schedule risks	-	o
Operation and maintenance risks	-	o
Maintenance costs (incl TAQA crossing)	-	+
Decommissioning	-	o

- -	*very poor*
-	*poor*
o	*neutral*
+	*good*
++	*excellent*

Table 1 Pro's and con's trenching and HDD option

This table provides a high over consideration and is meant to give an impression for both options. The detailed discussion is not included in this report.

10. Offshore section

This chapter describes the installation of the 220 kV submarine cables at the offshore section of the route as well as the 66 kV redundancy cable in between the two offshore substations. There are several different installation methods and trenching tools available on the market to install the HKZ offshore cables. This chapter provides an overview of the expected installation methods offered by the market which can meet the installation requirements.

10.1 Site description

The offshore section is the part of the cable route from the crossing of the TAQA pipeline (for the trenching option) or from the exit point of the HDD (for the HDD option) north of the Maasmond crossing to the offshore substation HKZ Alpha and HKZ Beta as seen in Figure 34.

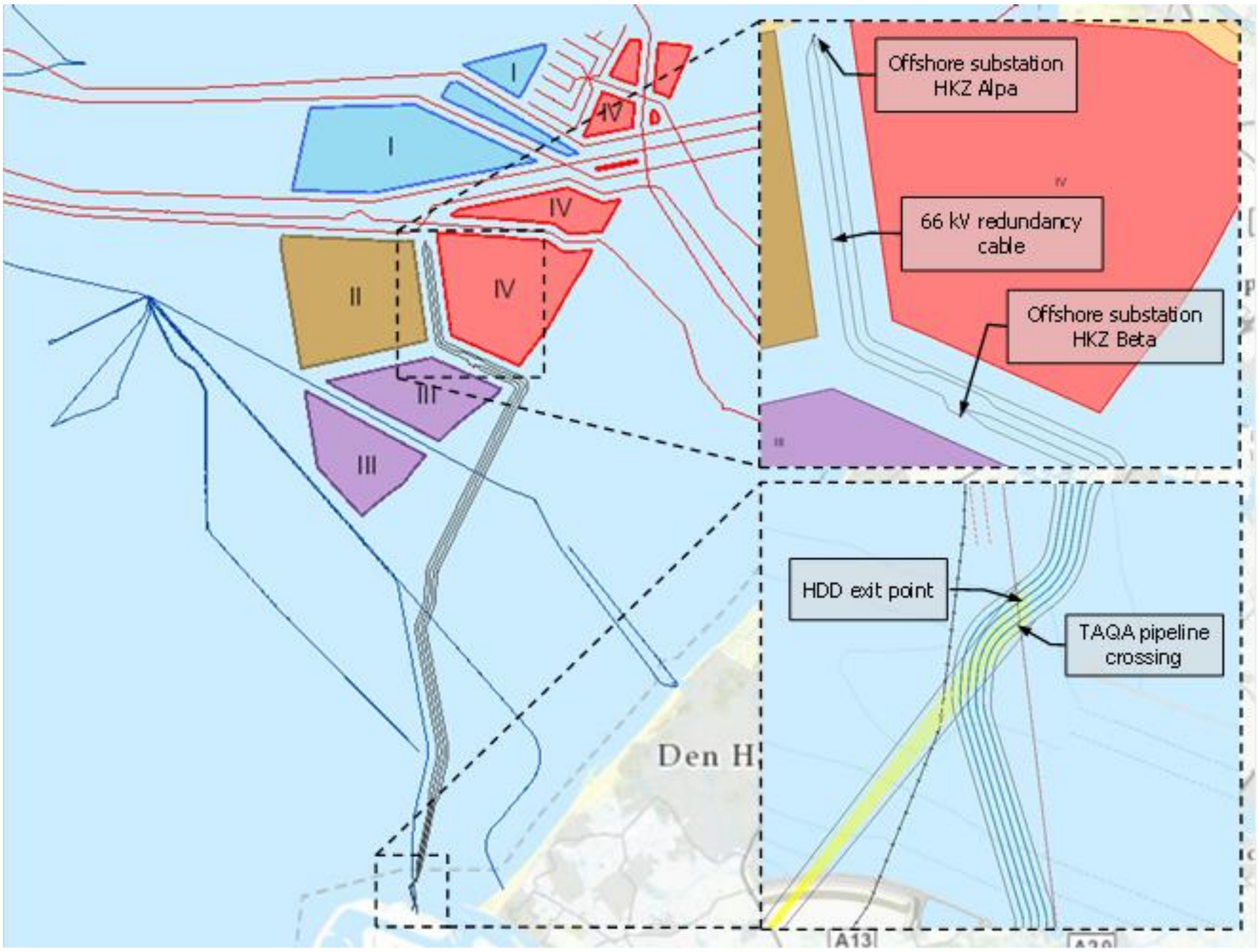

Figure 34 Offshore section

The cables are spaced 200 meter apart with a safety distance on either side of the outermost cables of 500 m (see Figure 35).

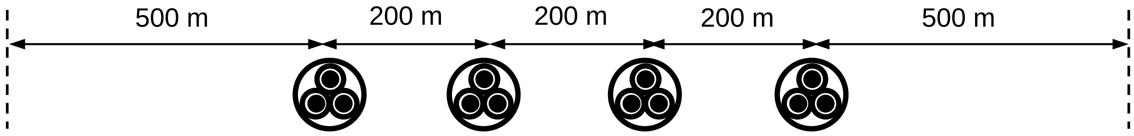

Figure 35 Cable corridor offshore section

10.2 Installation method

The installation of the 220 kV submarine cables for the offshore route will be either of the following options:

1. First end pull-in at the offshore substation and working towards the landfall or HDD seaward side.
2. Starting at the landfall or HDD seaward side (as described in chapter 9) and working towards the offshore substation where a second end pull-in will be performed to the platform.

In either of the options it is possible that there will be an offshore joint halve way down the offshore route. This however depends greatly on the length of cable that can be stored on the cable laying vessel. The 220 kV HKZ Alpha cables are each approx 42 km long and the HKZ Beta cables approx 34 km. It is likely possible to lay and bury the entire offshore section without an offshore joint. The installation of the approx 8 km long 66 kV redundancy cable in between the two offshore substations is executed in similar fashion.

Installation methods can be divided in two main groups. Simultaneous Lay and Burial (SLB) is a method in which the cable is laid and buried in one operation. This is done using one vessel and a trenching tool attached to the vessel. In contrast, Post Lay Burial (PLB) starts by laying the cable on the seabed with one vessel. Afterwards a second vessel will bury the cable with a trenching tool attached to this second vessel. Some installation tools can only be applied with SLB. Some installation tools that can be used with PLB, can also be used with SLB. Obviously, SLB would only require one single passage of an installation spread over the route. The advantage of PLB is that the laying of the cable will proceed approx. twice as fast compared to SLB. This significantly reduces the risk on cable damage as the probability on adverse weather would be reduced. Furthermore, if necessary the burial operation can be postponed during bad weather.

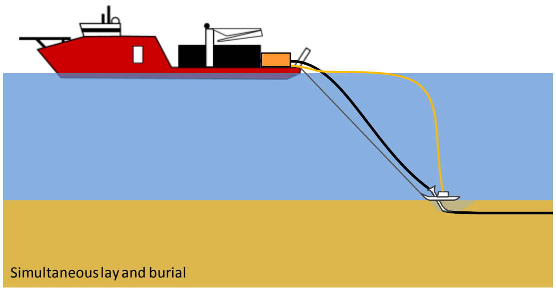

Figure 36 Simultaneous Lay and Burial (SLB)

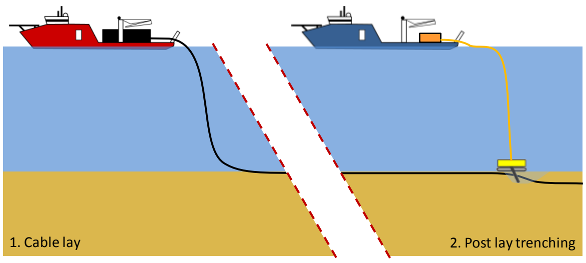

Figure 37 Post Lay Burial (PLB)

All installation vessels for the offshore section will be vessels with considerable draft to cope with high seas and maximise the carrying capacity. The latter is needed to minimize the number of cable joints. These vessels will most probably have a draft between 5 and 10 meters. A typical installation vessel has a loading capacity between 3,500 and 9,000 tons and is fitted with one or two turntables.

Figure 38 Deep water cable installation vessels

10.3 Trenching tools

A wide variety of equipment and vessels can be used to trench the cable into the seabed in order to provide protection to the cable against external threats. Each trenching tool has its own advantages and drawbacks. Some tools are more suited to specific sea or soil conditions than others. Jetting trenchers for example operate well in non cohesive sandy and soft clayey seabeds, while chain cutter trenchers are better fitted for tougher soil conditions like peat or stiffer clays. The benefits and disadvantages for each of the deployments of equipment and vessels span various features: speed, costs, weather dependability, risk to the integrity of the cable during trenching, likelihood of achieving the required depth of burial, draught, availability etcetera. Along the cable route in Maasmond section (only applicable for the trenching option) as well as offshore a varied mix of sea and soil conditions will have to be overcome. A grasp of these specific conditions: shallow and deeper waters, strong currents and quieter areas, high waves and calmer areas, soft and hard seabeds, smooth and coarse surfaces, seabed undulations etcetera. Various cable manufacturers operate different types of laying spreads and trenchers, each with their own specific track record relating to the specific cable types. At tendering stage the contractors will prepare a burial assessment study based on the provided soil information of the HKZ cable routes and on the specifics of the trenchers which they could offer. The

The following customary trenching tools are available for the offshore section. It should be noted though that this is not a limitative list. If other viable trenching tools emerge those can be deployed as well, provided that their effects on the environment are comparable with the described trenching tools:

1. Jet sledge
2. ROV jet trencher

3. Chain cutter
4. Cable plough
5. Mass flow excavation

10.3.1 Jet sledge

The least complicated cable trenching tools available on the market are the jet sledges. They are pulled by a barge or vessel for forward motion. The seabed is penetrated by water jets attached to the jet sledge and the cable is guided to the required depth through a cable duct.

Figure 39 Jet sledge

Jet sledges are available in different sizes with a depth of burial range from 1.5m to 3.0m with the Hydroplow or similar (see Figure 39) up to 8m with the BSS2 (see Figure 40).

Figure 40 The BSS2 jet sledge

10.3.2 ROV jet trencher

A Remotely Operated Vehicle jet trencher is an underwater robot controlled from a trenching support vessel. While moving over the beforehand laid cable, a trench is made in the seabed by means of water jets attached to the ROV jet trencher. The cable is guided between the two jetting arms. The cable slides in the trench by its own gravity. Re-sedimentation and natural backfilling fills the trench with suspended soils. With an open jet sword trencher the lowering of the cable depends on the flexing down of the cable into the fluidised soil behind the trencher as well as on the re-sedimentation velocity of the suspended soil particles in the trench. High voltage cables are bend-stiff and medium to coarse sand re-sediments quickly. This limits the effectiveness of open jet sword trenchers in sand. To improve the effectiveness of open jet sword trenchers, a so called backwash sword can be mounted at the rear end of the trencher, which injects a high flow of low pressure water in the trench, thus keeping the sediments suspended along a larger length of cable. This results in a larger depth of burial in medium to coarse sands.

Some ROV jet trenchers are fitted with a so called “depressor” which presses the cable down into the trench. The effectiveness of a depressor on a bend stiff subsea power cable however is limited and there is a risk that a depressor damages the cable while pressing it down into the trench. This has resulted in some reluctance to apply depressors on high voltage power cables.

Jet trenchers can be self-propelled (tracks/skids and/or thrusters), or dragged.

Figure 41 Jet trencher

10.3.3 Chain cutter

To cut open cohesive and harder soil layers like clay, peat or glacial till, chain cutters use a driven belt with metal cutting teeth or plates. The cut soil is being transported upwards and out of the trench by the cutter belt or it is placed back in the trench behind the trencher. The cable is guided downwards into the cut trench through a blade or stinger, it is depressed by a depressor to the required depth or it is allowed to lower itself by its own gravity, depending on the type of cutter trencher.

Figure 42 Chain cutter

For harder soil types such as cemented sands and soft rocks, wheel cutters are used. See for instance the TM04 depicted in Figure 24. The chains of chain cutters suffer from wear and tear on the hinges of cutter belt. Wheel cutters do not have that problem. Downside however is that the size of the cutter wheel is limited, which makes wheel cutters less suitable for the burial depths required in mobile seabed situations along the Dutch coast.

10.3.4 Cable plough

The difference between a jet sledge and a cable plough lies in the fact that a cable plough can be pulled through cohesive soils by force, where as a jet sledge only progresses through loosened sediments. Penetration in the seabed is achieved by a plough blade which digs itself into the soil. The cable is guided through the plough blade to the required burial depth, push downwards by a depressor. Optional jets on the plough blade facilitate soil penetration and reduction of pull forces, especially when ploughing in medium to dense sand. There are concerns with regards to the forces exerted on the cable when passing through a plough.


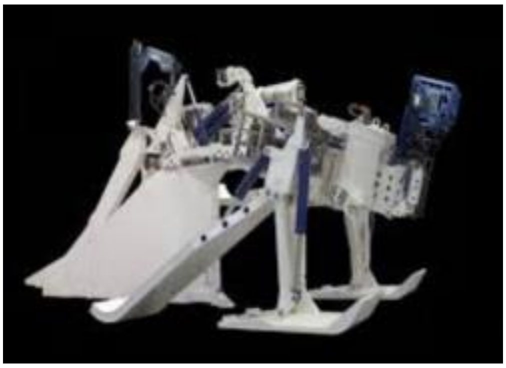

Figure 43 Cable plough

10.3.5 Mass flow excavation

A mass flow excavation tool creates a large, low pressure flow of water which is aimed at the cable. This fluidises soil around the cable which allows the cable to sink into the seabed. In medium to coarse sand as present in front of the Dutch coast the majority of the fluidised sand stays around the cable and re-sediments back into the trench after the MFE tool has passed over. In finer sand however, as present further offshore in the German Bight, MFE results in a more or less open trench with the cable at the bottom. The tide current and wave action will backfill the trench with surrounding soil material. This trenching tool has been used successfully for cable (re)burial on several high voltage power cable projects over the last years, amongst others BritNed and NorNed. TenneT will use this tool only on limited parts of the route, for instance to bury joints or to bury the cable in the direct vicinity of obstacles where a jet trencher cannot operate safely.

Figure 44 Mass flow excavation

Mass flow excavation can be executed by a dedicated MFE tool as depicted in Figure 44, as use don BritNed, or by a converted Suction Dredger or Hopper Dredger as shown in Figure 45. The latter has been used by TenneT to successfully rebury the NorNed cable in the Wadden Sea recently.

Figure 45 Mass flow excavation by a converted Suction Dredger or Hopper Dredger

10.4 Additional trenching tools

The following trenching tools are foreseen to be possibly used for the trenching option in the Maasmond crossing. These require a barge which can be used as cable storage, main operation platform, direct lay and burial methods or to pull other trenching tools.


Figure 46 Typical nearshore cable lay barges

Cable lay barges use anchors to manoeuvre in shallow waters or during trenching. See Figure 47 for a typical anchor layout that consists of four side anchors (1-4) and a main pull anchor (5). Depending on the actual weather situation, less then all five anchors can be used.

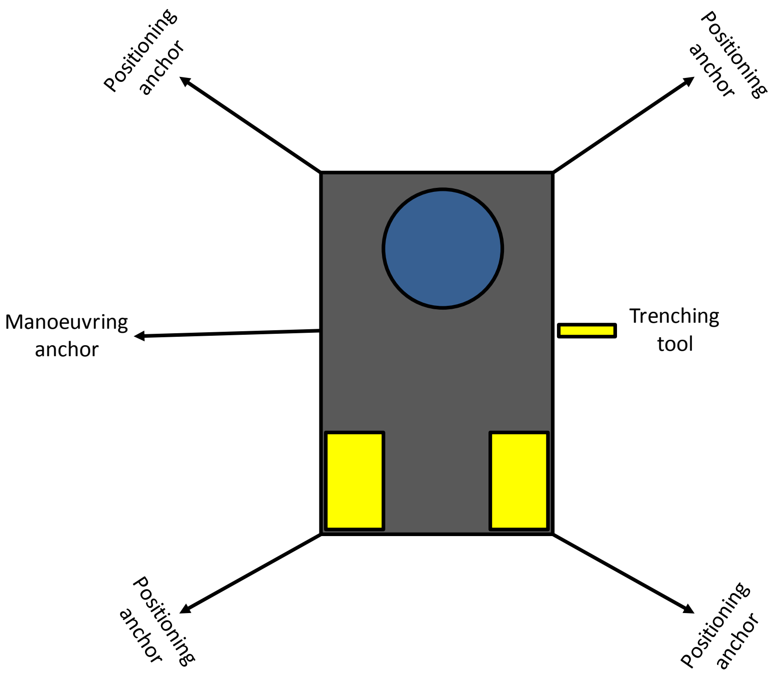

Figure 47 Typical anchor configuration of a nearshore installation barge

10.4.1 Vertical injector

In the essence a Vertical Injector is a very long jet trencher. A vertical injector penetrates soil by means of water jets. The cable is guided to the required depth through a vertical cable duct. It is deployed from a barge; its top end stays above the water line and is kept to the side of the barge or vessel. Vertical Injectors did prove themselves to be reliable cable trenching tools for XLPE cables, simple and robust and specially designed for nearshore operation. Burial depths up to 10 meter have been achieved. Vertical Injectors are typically deployed from a barge on anchors, but it can be deployed as well from a vessel on DP using just a pulling anchor.

Vertical Injector like trenchers have been used in the Zeeland in the Westerschelde to bury power cables.

Vertical Injector	
Jetting head	0 - 5m
Max. trench depth	16m
Operating depth	max. 50m in 5m steps
Water supply	2 x 1200m³/h (2x 1000kW)
Water pressure	16 bar
Upper Pennant Winch	2 x winches, DMT
Lower Pennant Winch	2 x winches, Weser Pumpen

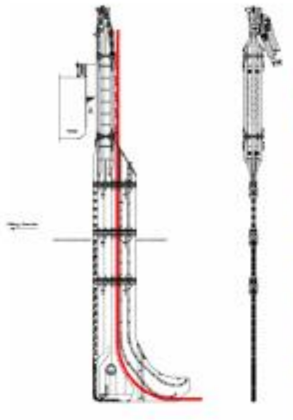

Figure 48 Vertical Injector

Figure 49 Cable installation by a vertical injector like trencher in Zeeland

Figure 50 Detail of the barge mounted Vertical Injector like trencher in Zeeland

10.4.2 Vibration plough

Vibration has the capability of fluidising non cohesive soils like sand and of breaking open cohesive soils like clay or peat. A vibration plough fluidises or opens up soil by means of a vibro sword. The cable is guided to the required depth through a duct in the sword.

Figure 51 Vibration plough deployed from a barge

Figure 52 Vibration plough on tracks

The advantage of a vibration plough is that it requires less jetting water thus causing less turbidity. The downside however is the noise and the disturbance caused by the vibrations.

10.5 Dredging

There will be two types of area where dredging preceding the installation of the cables will be required along the HKZ cable routes:

1. In the Maasmond in case of lay and trenching. Dredging is to ensure that the Maasmond is deepened to the maximum maintenance depth plus a certain margin in case 3m burial by a jet sledge of ROV jet trencher will be needed below that lowest maintenance level.
2. Along the route sections with mobile sand waves, to create a non mobile reference level as depicted in Figure 9 and as described in 0.

The dredging preceding cable installation will be limited by the maximum dredging volume as per installation permit. After trenching of the cable into the bottom of the pre dredged trench, no active backfilling of the trench will be executed, backfilling of the dredged trench will be left to nature.

The dredging can be done by Trailing Suction Hopper Dredgers, or "hopper" in short. Hopper dredgers are versatile dredging tools which are capable to work in the challenging conditions with waves and currents in the nearshore section.

Figure 53 Trailing Suction Hopper Dredger

Once the hopper approaches the trench location, it lowers the drag head attached to the lower end of the suction pipe to the seabed. The soil is loosened by the cutting and jetting characteristics of the drag head teeth and jets. The dredge pump located in the vessel’s hull sucks the loosened soil from the seabed to form the trench. The removed soil is raised via the suction pipe into the vessel’s hopper. The dredged soil is kept in the hopper whilst the water leaves the hopper via an overflow.

The volumes to be dredged, the production of the dredging equipment and the time required for the dredging operations will be engineered during the preparation phase of the project.

11. Crossings with 3rd party assets

The 220 kV submarine cable route crosses some in service 3rd party subsea assets, for instance the TAQA pipeline at the Maasmond as well as another TAQA 10"pipeline further offshore. This chapter describes the different crossing methods for those in service assets.

11.1 Cable detection survey

Prior to cable installation operations a survey will be performed to locate the In Service and the Out Of Service subsea assets. The results of this survey will be used for the detailed design of the crossing structures. Information provided by the owners of the subsea assets will be used for this survey, for instance their last route inspection survey data.

11.2 In Service assets

11.2.1 Crossing agreements

For all the crossings with In Service subsea assets crossing agreements will be set up between TenneT and the owner or operator of the subsea asset to cross. In these crossing agreements amongst others the communication lines will be defined between TenneT and the owner / operator for the period of the construction of the HKZ and afterwards. Technical details of the crossing structure to be applied will be agreed upon as well in the crossing agreement.

11.2.2 Crossing structures

Four types of crossing structures are considered suitable for the crossings with In Service subsea assets. Each crossing structure has a means of creating separation between the subsea asset and the power cable of typically 0.3m or more a means of protecting the cable where it is laid over the 3rd party subsea asset.

1. Separation by rock placement, outer protection by rock
2. Separation by concrete block mattresses, outer protection by rock
3. Separation by a separator system around the power cable, outer protection by rock
4. Separation by lowering the 3rd party subsea asset into the soil, outer protection by rock

Which crossing structure will be applied where depends on the outcome of the crossing agreement negotiations.

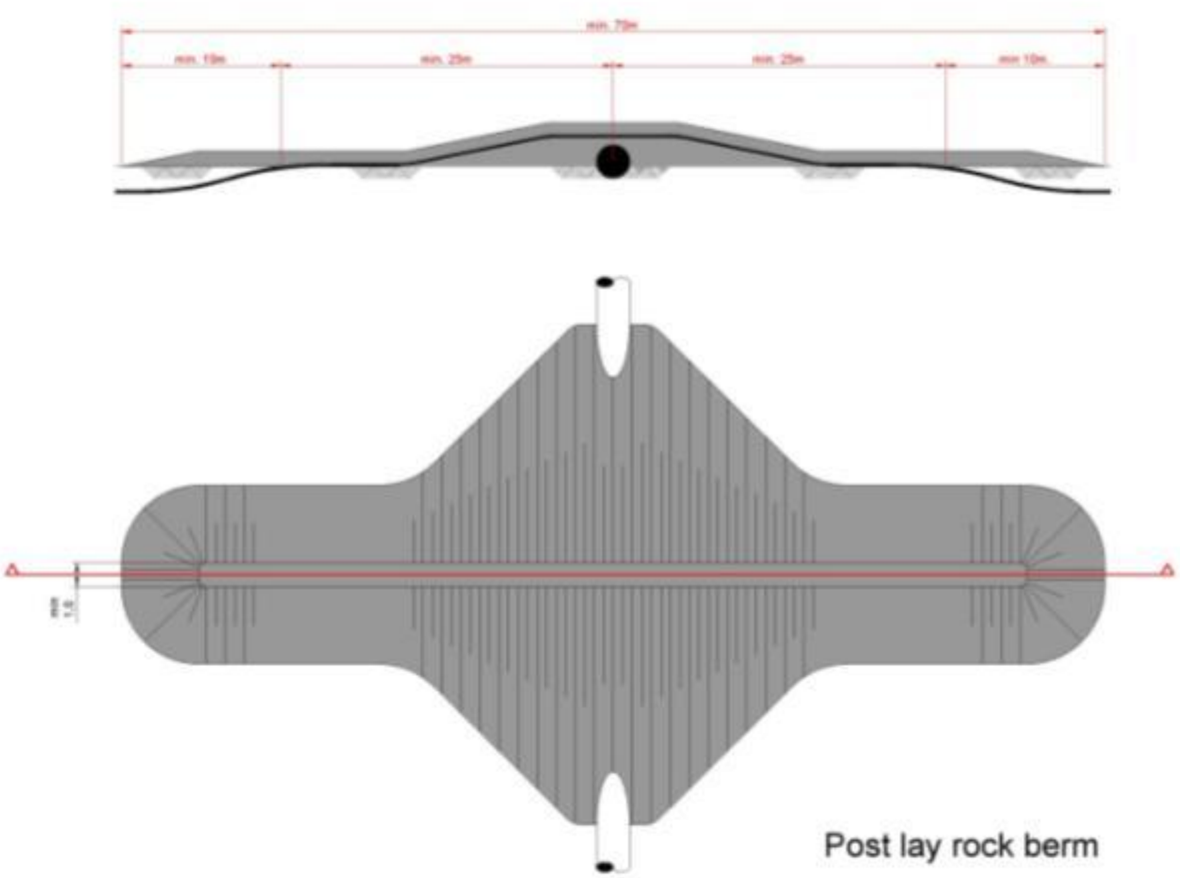

Figure 54 Typical rock - rock crossing structure

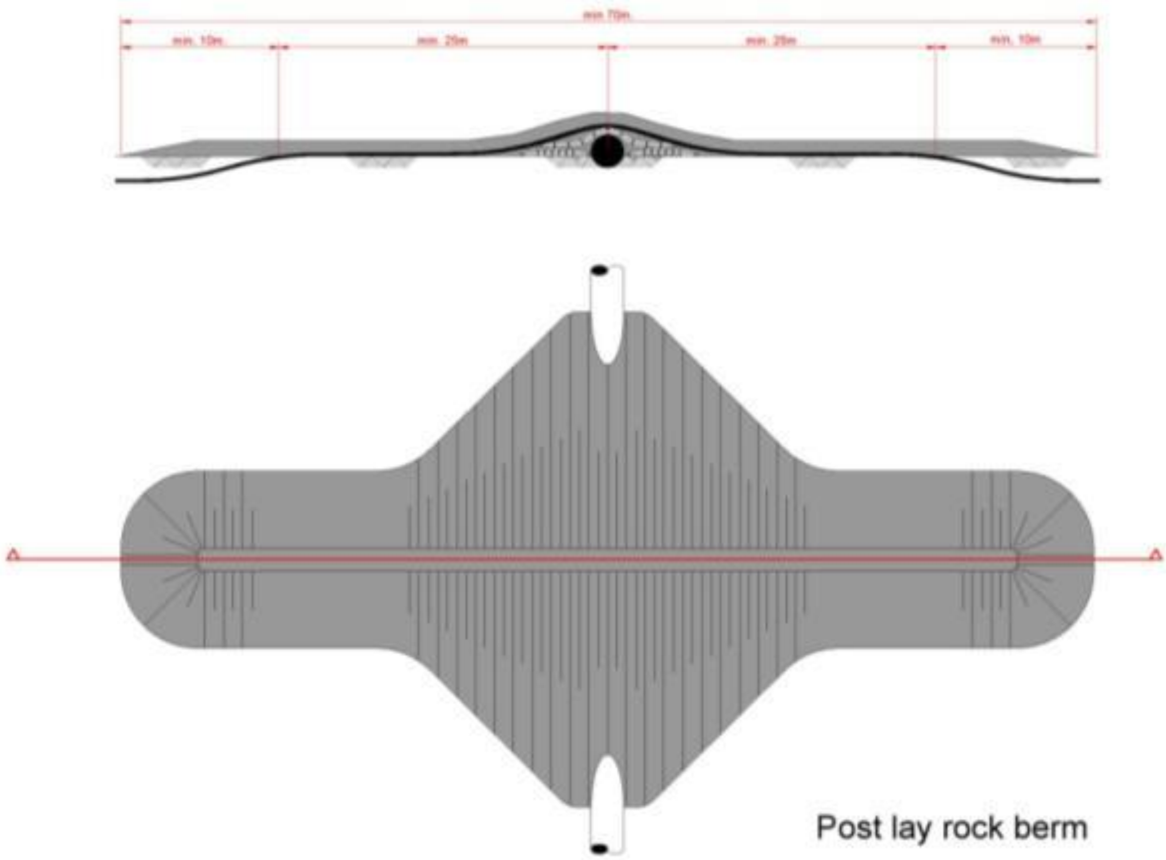

Figure 55 Typical mattress - rock crossing structure

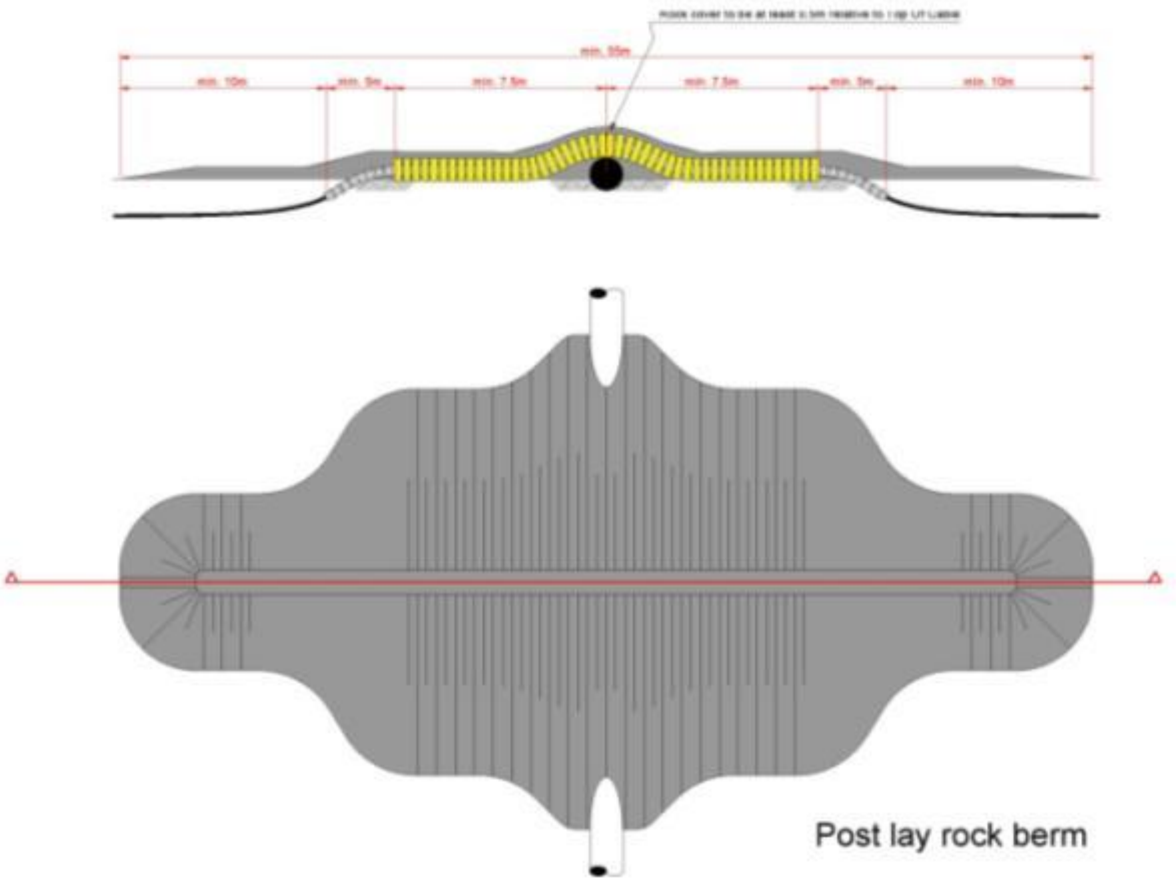

Figure 56 Typical separator - rock crossing structure

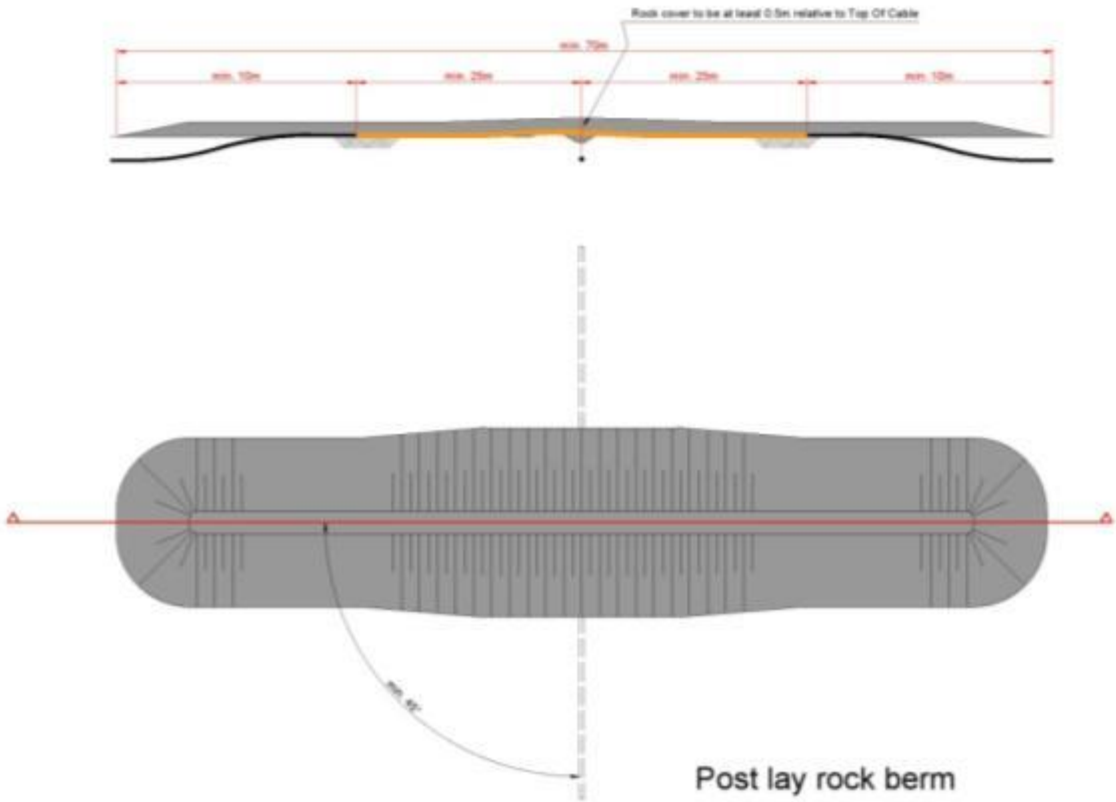

Figure 57 Typical lowering 3rd party asset - rock crossing structure

11.2.3 Outer rock layer

The outer rock layer of the crossing structures will be designed to be dynamically stable under design storm and current conditions. This means that some movement of the rock is allowed under design storm conditions as long as the cover of the cable by the rock layer stays sufficient to protect the cables against external threats. The movement of the rock under storm conditions results in less steep side slopes of the rock berm, which stabilises the rock berm. Therefore some displacement of rock increases the stability of the rock berm.

On top of the outer rock layer a sprinkler layer of gravel will be placed to minimise the risk on hooking by fishing gear, as required by the SODM (Staatstoezicht op de Mijnen).

12. Post installation activities

12.1 Remedial burial by jet trenching or MFE

Along sections of the route where the initial cable burial operations did not result in the required burial depths, additional cable burial can be preformed either by a ROV jet trencher or be mass flow excavation, depending on the local situation.

12.2 Post lay protection of cable segments

At locations where de cables could not be buried into the seabed, for instance at crossing locations or at locations where unexpected obstacles where encountered during the cable trenching operations, the cables can be post lay protected by rock placements. Rock placements however will be avoided as good as possible as rock placements have the tendency to attract erosion on its edges, which will require maintenance over time. Rock will be placed on these cable sections using a fall pipe vessel, which allows for very accurate rock placement.

12.3 As built survey

After the completion of the installation operations a dedicated as built survey will be conducted to measure the actual burial depth along the full cable routes

During the installation of the cables the penetration depth of the trencher can be used as the as-trenched survey, provided the cable depth is physically determined by the applied trencher.

The dedicated as built survey will establish the bathymetry along the cable route after installation as well as the depth of burial of the cables. There are several methods to establish the depth of burial of subsea power cables, they can however be split in the following groups:

1. Passive electromagnetic methods which transmit a changing electromagnetic signal into the seabed and measure the response of the cable to this changing field. These methods have a limited penetration depth and are therefore only suitable for shallowly buried cables. Example: TSS440.
2. Active electromagnetic methods which use an electromagnetic tone put on the cable to measure the burial depth of the cable. A tone can only be put on a cable when it is not in use, therefore a subsea power cable has to be taken out of operation for such a survey. This survey method however is suitable to measure larger depth of burial of cables compared to the passive method. Example: TSS350, DoBStar and Orion.
3. Electromagnetic methods which use a signal transmitted by the cable system to measure its depth of burial. This method can for instance make use of higher harmonic ripples on direct current interconnectors. Example: DoBStar and Orion
4. Acoustic methods which use the reflections of acoustic signal on the cable to measure its depth of burial. This method however requires relative large instruments and is therefore more complicated and more costly. Example: PanGeo SBI.

The permit prescribes the depth of burial of the cables to be established periodically over the lifetime of the cables, typically once a year over the first three years of its operational lifetime. If the cables have proven to be well buried, the permit allows for a request for relaxation of these surveys.

The depth of burial of a cable can change over its lifetime as a result of changes in the seabed. Seabed mobility changes the depth of burial of a cable over time. A subsea power cable does not move within in the seabed. If the changes of the seabed over time are accurately measured, the changes in the depth of burial of the cables can be established based on a comparison between the most recent survey and the as built survey, provided the as built survey has been a continuous and reliable survey. Bathymetrical surveys over a cable route can be performed at significantly lower costs than surveys measuring the depth of burial of the cable in the seabed. From a cost efficiency perspective therefore a continuous and dedicated as built survey of the installed cables will be preformed such that the consecutive route surveys to check the burial depths of the cables can be performed by just bathymetrical surveys.

13. Decommissioning

13.1 Cables

At the end of their operational lifetime the HKZ cables will be removed from the seabed in accordance with the requirements stipulated in the permits. Removal will only be preformed where the environmental impact of removal is less than the impact of leaving the cables in place on the environmental and on navigation.

The cables will be pulled out of the seabed using a jet trencher where needed. The cables will be cut in sections on deck and brought to shore for material recycling.

13.2 Crossing structures

At the locations of the crossings with 3rd party subsea assets, the crossing structures will be removed. This will involve removal of rock placements by means of a grab dredger. The recovered rock will be brought to land for recycling purposes.

Any remains of our of service pipelines or out of service cables underneath the HKZ cables will be removed during decommissioning as well, provided the overall impact on the environment benefits from such a removal.

13.3 Maasmond crossing

At the Maasmond crossing the cables will most likely not be removed at decommissioning, as the Port of Rotterdam and the responsible authorities are expected to prefer remnants of the HKZ cables buried in the seabed at the Maasmond above hindrance to shipping as a result of the removal of the HKZ cables.

On the other hand, if removal of the cable in the Maasmond is desired by the authorities and Port of Rotterdam, then the cables will be pealed out of the seabed using a jetting tool to loosen the seabed up front. The recovered cable will be cut in short sections and recycled at port.

III

BIJLAGE: BASIC DESIGN RAPPORT

OFFSHORE GRID NL

E3.1.5

Document Title:

Standard Offshore Substation

Basic Design Report

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OFFSHORE GRID NL

STANDARD 700 MW AC OFFSHORE SUBSTATION

BASIC DESIGN REPORT

STANDARD 700 MW AC OFFSHORE SUBSTATION

BASIC DESIGN REPORT

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CONTENTS

1. INTRODUCTION

1.1 Purpose of this document

This Basic Design Report, together with the related documents specified in Master Document Register (ONL-TTB-00019), presents the basic design of Employer's standard 700 MW AC offshore substation.

This basic design provides the basis for the detail design of project specific substations to be deployed in Employer's offshore grid connections.

The basic design report covers the platform and all auxiliary systems needed to support the HV power transmission process. The design of the HV system is covered in a separate report [1].

This basic design report consist of three parts. Part 1 states the basis of design. Part 2 covers the platform concept. Part 3 outlines the basic design including the functional requirements.

1.2 Background

The Dutch government has decided to develop 3.5 GW of wind energy production capacity offshore The Netherlands by 2023.

To achieve this the Dutch government will from 2015 onwards tender five 700 MW wind farm zones, one every consecutive year. Every wind farm zone comprises two wind farm sites of approximately 350 MW each.

Further background information concerning this development can be found in reference [3] E2.1 - Project and site description Borssele I and II as well as on www.windopzee.nl.

TenneT, as the offshore grid operator in the Dutch part of the North Sea, will be responsible for the design, fabrication, installation and operation of the grid connections which will transport the generated electricity to shore.

Within each of these grid connections an 700 MW AC offshore substation is included. In order to minimize the total cost of ownership, TenneT has, in-house, developed a standard platform up to the level of basic design. This basic design has been appraised by DNV GL.

The substations will be located along the Dutch coast as indicated in Figure 1-1.

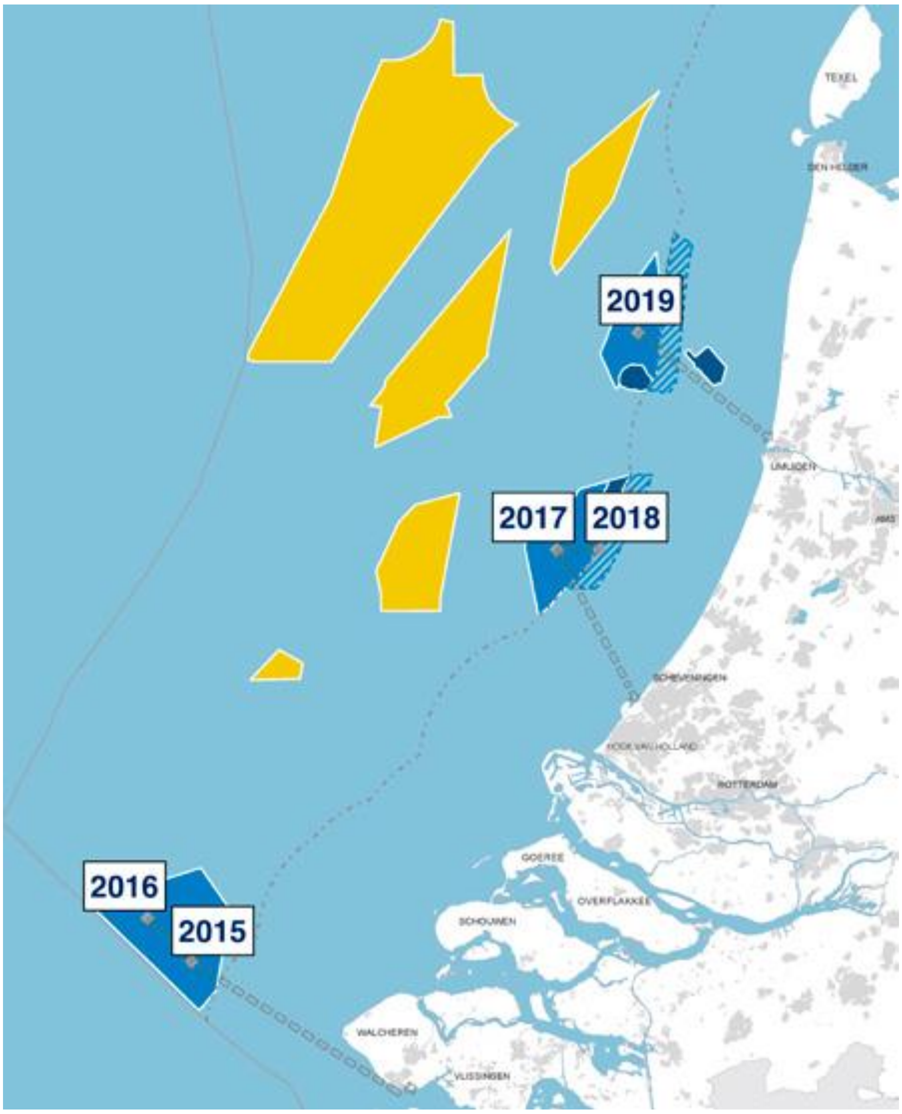

Figure 1-1: Wind farm zones to be tendered are marked light blue, realised wind farms in dark blue, future wind farm zones in yellow.

The names of the planned substations and their respective planned years of completion are:

- Borssele Alpha 2019
- Borssele Beta 2020
- Hollandse Kust Zuid-Holland Alpha 2021
- Hollandse Kust Zuid-Holland Beta 2022
- Hollandse Kust Noord-Holland Alpha 2023

1.3 Purpose and concept of the standardised 700MW AC Offshore Substations

The 700 MW AC offshore substations are to carry high-voltage switching and transformation equipment as well as auxiliary facilities. Connecting voltage of the wind farms will be delivered to the substations at a voltage level of 66 kV, the export cables will be operated at 220 kV.

The substations are part of the larger project of grid connection realization. The other parts, being the sea cables and the onshore substation extension, will be executed in parallel to this platform contract.

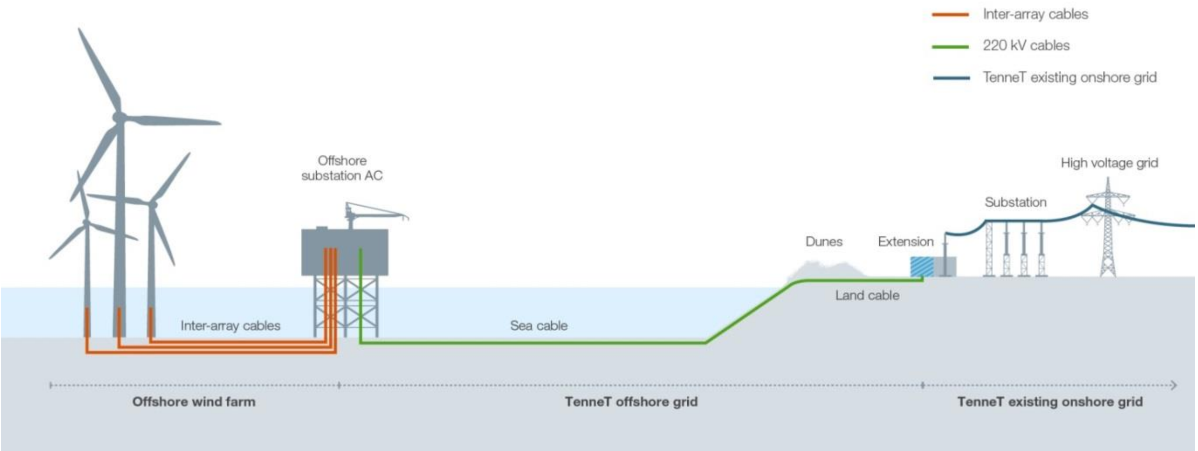

Figure 1-2: The Grid Connection System (GCS) from TenneT

The platform will consist of a lift installed topside, on top of a steel jacket piled to the seabed. J-tubes are foreseen in the jacket for pulling-in the 66 kV inner array cables of the connecting wind farms and the 220 kV export cables.

The platform will be unmanned, with no living quarters and no helideck provided. The platform auxiliary systems shall be fully automated. Remote monitoring and control shall be possible from the onshore control centre. Local monitoring and control shall be possible during manned maintenance campaigns.

Figure 1-3: Platform view.

1.3.1 Final deck configuration

The basic design is based on following deck designations and elevations:

Cable deck	EL. +20.000 T.O.S
Main deck	EL. +26.500 T.O.S
Utility deck	EL. +34.000 T.O.S
Control deck	EL. +38.000 T.O.S
Roof deck	EL. +42.000 / 44.000 T.O.S

Figure 1-4: Basic design deck configuration

However, the effective cable deck height to be considered during detail design follows from drawings:

- E3.1.8 Cable Deck – 66kV Infield Cables routing, ONL-TTB-03556
- E3.1.9 Cable Deck – 220kV Export Cables routing, ONL-TTB-03557

Therefore, during detailed design, construction and installation, the following deck designations and elevations shall be used as basis:

Cable deck	EL. +20.000 T.O.S
Main deck	EL. +27.500 T.O.S
Utility deck 1	EL. +35.000 T.O.S
Utility deck 2	EL. +39.000 T.O.S
Roof deck	EL. +43.000 / 45.000 T.O.S

Figure 1-5: Detailed design deck configuration

2. DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

Platform:	A complete HV substation, including or excluding the HV equipment.
Offshore substation:	Project specific offshore transformer platform(s) part of a grid connection system.
Standard platform:	TenneT's in-house standard design as a basis for five 700 MW platforms.
High voltage (HV):	$U_n > 1$ kV
Low voltage (LV):	$U_n < 1$ kV

2.2 System categories

Primary Systems:	These are systems and equipment which are directly related to the receipt of HVAC power from the offshore wind farm, the conversion of the voltage level and it's transmission ashore via the sub-sea cables. Primary the HV equipment (GIS, Transformer, HV Cables, etc.)
Secondary Systems	These are systems and equipment which Control and Protect the HVAC systems.
Auxiliary Systems	These are all other systems on the platform.
Design life	The period of time during which the functionality of the platform shall be available.

2.3 Abbreviations

In the report, the following words, expressions and abbreviations have the meanings stated in the following:

AC	Alternating Current
AED	Automated external defibrillator
AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
ATEX	Atmosphere Explosibles
BS	British Standard
BWFZ	Borssele Wind Farm Zone
CAA	Civil Aviation Authority
CCTV	Closed Circuit Television
CDF	Cobber Distribution Frame
CE	"Marking" - conformity to European Directive
COG	Centre of Gravity
CPD	Construction Product Directive
CPR	Construction Product Regulation
CTV	Crew Transfer Vessel
DC	Direct Current
DNV	Det Norske Veritas
EC	European Community
EERA	Escape, Evacuation and Rescue Analysis
EMC	Electromagnetic Compatibility
EN	European standards
EU	European Union
FAS	Fire Alarm System
FES	Fire Extinguishing System
FSS	Forged Stainless Steel

GIS	Gas Insulated Switchgear
GRP	Glass Fibre Reinforced Plastic
HAT	Highest Astronomical Tide
HMI	Human Machine Interface
HP	High Pressure
Hs	Significant wave height
HV	High voltage
HVA/C	Heating, Ventilation and Air Conditioning
HVAC	High Voltage Alternating Current
I/O	Input / Output
IALA	International Association of Marine Aid to Navigation and Lighthouse Authorities
IEC	International Electrotechnical Commission
IMO	International Maritime Organization
IP	Internet Protocol
ISO	International Standardisation Organisation
ITU	International Telecommunication Union
LAN	Local Area Network
LAT	Lowest Astronomical Tide
LSA	Life Saving Appliances (also IMO LSA Code)
LV	Low Voltage
MED	Marine Equipment Directive
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
MLWN	Mean Low Water Neap
MLWS	Mean Low Water Spring
MSL	Mean Sea Level
MV	Medium Voltage
NEN	Dutch Norm
NFPA	National Fire Protection Association
NORSOK	Norwegian Offshore Standard
ODF	Optical Distribution Frame
OSPAR	Oslo-Paris Convention
OSS	Offshore Substation
PA	Public Address
PE	Poly Ethylene
PED	Pressure Equipment Directive
PPE	Personal Protection Equipment
QRA	Quantitative Risk Assessment
RAM	Reliability – Availability - Maintainability
ROG	Ramboll Oil & Gas
SCADA	Supervisory Control and Data Acquisition
SOLAS	Safety of Life at Sea
T.O.S.	Top of Steel
ULS	Ultimate Limit State
UPS	Uninterrupted power supply
UV	Ultra Violet
VLV	Very Low Voltage
VoIP	Voice over IP (telephone system)
W2W	Walk to Work, heave compensated gangway
WFO	Wind Farm Owner
WPO	Wind Park Owner

2.4 References

1. E3.1.2; Grid Connection System (GCS), ONL-TTB-03152
2. E2.2; List of Employer free issued material, ONL-TTB-03131
3. E2.1; Project and site description Borssele I and II
4. E6; O&M Requirements, ONL-TTB-03426
5. E2.7; RAM requirements, ONL-TTB-03147
6. MetOcean and Geotechnical data, http://offshorewind.rvo.nl/generalborssele
7. E3.1.8; Field lay-out; ONL-TTB-03158
8. E3.1.7; Cable Pulling Methodology, ROGE-Z-RA-000420
9. E3.1.10; Room matrix and master equipment list, ONL-TTB-00105

PART 1, BASIS OF DESIGN

3. CODES AND STANDARDS

The basic design of the Employer's standard platform is based on the following Laws, codes and standards. The further development of the platform shall comply with the Laws, codes and standards as stated in paragraph 3.2, 3.3, 3.4 and 3.5.

3.1 Order of Precedence

In the event of conflicts among the Laws, rules, regulations, specifications and standards referred to in this Basis Design Report the following order of precedence will be used:
1. International and Dutch Laws and regulations.
2. This Basis Design Report and referenced documents.
3. International codes and standards

All regulations, codes and standards referred to in this Basic Design Report shall apply in the revision in effect at the time of contract signing.

3.2 International regulations

The governing standards to be applied for the design of the platform shall comply with the following.

- IMO (International Maritime Organization)
- SOLAS
- Marpol
- LSA Code (Life Saving Appliances)
- FSS Code (Fire Safety Systems).
- CAA (Civil Aviation Authority)
  - CAP 437: Standards for Offshore Helicopter Landing Areas.
- IALA (International Association of Marine Aid to Navigation and Lighthouse Authorities)
  - IALA Recommendation O-139, The Marking of Man-Made Offshore Structures

3.3 Dutch regulations

Statutory regulations to be used are (but not limited to): The latest edition shall be applicable.
- Dutch electricity Act (Elektricitetswet 1998)
- NEN 1010, Safety requirements for low-voltage installations, Oct 2015
- NPR 5310, Netherlands interpretation guide to NEN 1010
- NEN 3140, Operation of electrical installations – Low voltage
- NEN 3840: Operation of electrical installations – High voltage
- NEN-EN 50110: Operation of electrical installations
- NEN-EN 61936: Power installations exceeding 1 kV
- Mijnbouwwet, Mijnbouwbesluit, Mijnbouwregeling (Dutch Mining Regulation)

Furthermore, Dutch regulation implementing the EU Directives listed in 3.4.

3.4 EU directives/regulations

The following EU Directives and regulations, as implemented in Dutch regulations, shall apply:
- 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora
- OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations
- 2004/108/EC: Electromagnetic Compatibility
- 2006/42/EC: Machinery Directive
- 2006/95/EC: Low Voltage Directive

- Regulation 305/2011: Construction Product Regulation (CPR) (***)
- Regulation 1272/2008: CLP Regulations (Chemicals)
- 89/106/EEC: Construction Product Directive (CPD)
- 89/686/EEC: Personnel Protection equipment (PPE)
- 2003/10/EC: Minimum Health and Safety Requirements. Noise
- 90/269/EEC: Health and Safety Requirements for Mechanical Handling of Loads
- 97/23/EC: Pressure Equipment Directive (PED)(*)
- 2009/105/EC: Simple Pressure Vessel Directive
- 92/58/EEC: Safety and Health Signs
- 96/98/EC: Marine Equipment Directive (MED)
- 2001/95/EC: General Product Safety Directive
- 1999/92/EC, ATEX Worker Protection Directive
- 94/9/EC: ATEX Equipment Directive (**).

(*): New Pressure Equipment Directive, 2014/68/EU becomes mandatory from mid-2016. Rules for fluid classification, based on the CLP regulation, will be adapted from the new directive from 1 June 2015 into directive 97/23/EC
(**) New ATEX Directive, 2014/34/EU becomes mandatory from April 2016
(***) CPR shall only apply for shelter and for commodity items, i.e. for example fabricated steelwork shall not be CE-marked according to CPR / EN 1090-1.

3.5 Codes and standards

Governing standard for the design of the platform shall be:

- DNVGL-ST-145 Offshore Substations

All normative Codes and Standards referred to in the above mentioned governing standard shall be followed. In addition the following Codes and Standards shall be followed:

1. DNVGL-OS-A101, Safety Principles and Arrangements
2. DNVGL-OS-C101, Design of Offshore Steel Structures, General (LRFD Method)
3. DNVGL-RP-0005, (DNV-RP-C203), Fatigue design of offshore steel structures
4. DNVGL-OS-C401, Fabrication and testing of Offshore Structures
5. DNVGL-OS-D101, Marine and Machinery Systems and Equipment
6. DNVGL-OS-D201, Electrical Installations
7. DNVGL-OS-D202, Automation, Safety and Telecommunication Systems
8. DNVGL-OS-D301, Fire Protection
9. DNV-OS-H101, Marine Operations, General
10. DNV-OS-H102, Marine Operations, Design and Fabrication
11. DNV-OS-H201, Load Transfer Operations
12. DNV-OS-H203, Transit and Positioning of Offshore Units
13. NORSOK C-002, Architectural components and equipment.
14. NORSOK M-501, Surface preparation and protective coating

If any inconsistency is found between the codes and standards, the following hierarchy is valid:

1. DNVGL-ST-145 Offshore Substations
2. DNV-GL
3. Noble Denton Guidelines
4. NORSOK guidelines
5. European standards (EN), International standards ISO and IEC standards, NFPA for firefighting and IP 15 regarding hazardous area classifications.

All EN and EN-ISO standards shall be in the NEN-version. For Euro codes, national NEN annexes shall be applied.

4. DESIGN REQUIREMENTS

4.1 Operation and Maintenance design requirements

Operation and Maintenance design requirements are

- The platform shall have a design life of 30 years from Taking Over (as defined in the relevant EPC contract).
- All structural and non-structural items (i.e. piping, ducts and J-tubes, architectural walls, doors and windows) shall have a design life of 30 years. All other systems shall have a design life of 20 years. In these periods, all structures, systems, equipment and surfaces shall be designed to be able to withstand, with normal maintenance applied, normal wear and tear, aging and corrosion due to intended use and ambient conditions during the entire periods specified without any need for unplanned maintenance or replacement.
- The platform design shall fulfil the requirements for reliability, availability and maintainability as further specified in the RAM requirements [5].
- The platform will be unmanned. The platform systems shall be fully automated. Remote monitoring and control shall be possible from the onshore control centre. Local control shall be possible during manned maintenance campaigns.
- The platform and the lifesaving appliances shall be designed to allow 12 persons onto the platform during normal maintenance campaigns.
- The maintenance plan shall be based on execution of planned maintenance in the period April–September with a maximum number of campaigns of four per year.

This chapter should be read in conjunction with the Operation and Maintenance Requirements[4].
O&M Requirements, ONL-TTB-03426

4.2 Provisions for subsea cable entries

The platform shall be fitted with:

- 20 J-tubes for pull-in of subsea power cables need to be provided, of which:
  - 2 times 8x for 66 kV cables for the two wind area's to be connected to the substation
  - 1x 66 kV cable for a possible experimental wind farm to be connected (only applicable on Borssele Beta)
  - 1x 66 kV cable to a second substation in the same wind area
  - 2x 220 kV export cables
- A cable deck to allow subsea cable pull-in before (and after) installation of the topside

Subsea cables can only enter the substation in the N, W and S quadrants of the substation site. The E quadrant shall be kept free from subsea cables to allow access to the substation for a jack-up barge.

4.3 Temperature requirements

		Tmin/max Unmanned	Tmin/max Manned[1]	Humidity
GIS (66&220)		5/35	5/35	10-70%
Main transformer	Naturally ventilated room	-/40	-/40	-
Shunt reactor	Naturally ventilated room	-/40	-/40	-
Control rooms		5/35	19/24	10-60%
Auxiliary and earthing transformer room	Naturally ventilated room	-/40	-/40	-
LV sub-distribution		5/35	5/35	10-60%
Battery room		15/25	15/25	10-60%
Public room		5/35	19/24	10-60%
Workshop		5/35	16/25	10-60%
Toilet		5/35	16/25	10-60%
Utility machinery rooms		5/35	5/35	10-70%
[1]HVA/C system for manned modes does not have to be redundant.				

Figure 4-1: Temperature requirements

Temperature requirements from individual rooms are presented in the Room Book [9].

4.4 Noise and vibration requirements

Requirements to maximum noise level in individual rooms are presented in the Room Book [9].

4.5 Environmental and Geotechnical data

For the basic design, the metocean and geotechnical data for the Borssele Alpha platform location have been used. Relevant data are provided in the individual design reports. The data can be found at the website of the Offshore Wind of the Netherlands Enterprise Agency RVO [6].

4.6 Item Designation

Item designation shall be according to Employer standard: E5.19 Item Designation, RDSPP Numbering System, document number ONL-TTB-03424.

PART 2, PLATFORM CONCEPT

5. DESIGN CONCEPT

5.1 Platform design

The main value drivers for this lay-out are:

- arranging all (heavy) HV equipment on the main deck results in a low CoG and optimal HV cable routing.
- making the cable deck part of the jacket allows early subsea cable pull-in, even before installation of the topside.
- this lay-out allows the shunt reactors to be deleted without affecting the remainder of the topside lay-out. Shunt reactors will not be needed for platforms with short export connection to the onshore grid.
- optimized operation and maintenance through selection of low complex systems and solutions.
- placing most of the gangways externally, this minimizes the volume of the topside enclosure. Thereby minimizing weight and cost, while at the same time providing for easy maintenance of the exterior.
- special attention has been paid to provisions for the exchange of heavy components such as the transformers and the reactors. Laydown platforms are foreseen on all levels within reach of the platform crane. Adequate provisions are foreseen for material handling in the broadest sense.
- the lay-out provides effective escape routes as well as comfortable indoor passage between the most visited rooms.
- two muster and life raft stations (one North and one South) are provided to always allow escape on a lee side of the platform.
- boat access is provided by two CTV boat landings and four W2W gangway landing areas, allowing vessels to always approach from the most favourable angle. A helicopter winching area is provided for emergency situations.

The platform lay-out is shown in the 3D model (ONL-TTB-00003) and the plot plans (ROGE-R-LA-000092).

5.2 Structural arrangements

The design concept is based on a 4-legged steel jacket designed for sleeve piling. The jacket is configured with two 'false' legs, which allow for six-point interface to the topside and provide sufficient space to have all J-tubes arranged internal to the jacket. The central part of the cable deck is included in the jacket structure and arranged for cable pulling before and after installation of the topside.

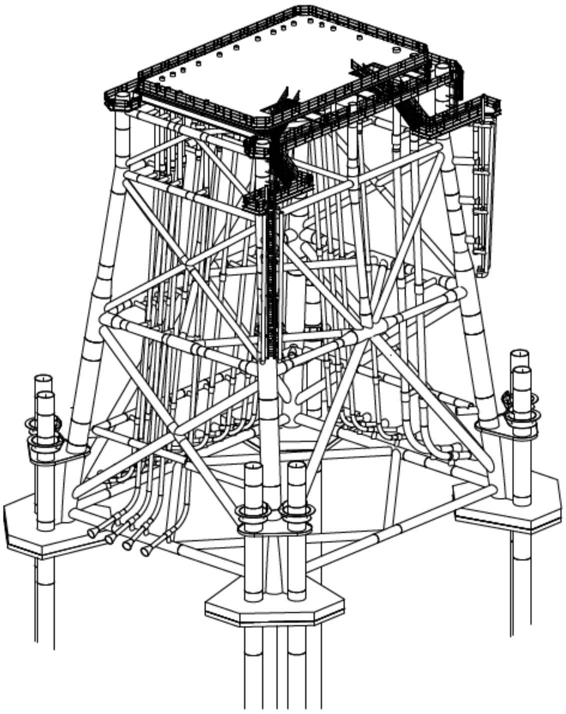

Figure 5-1: Jacket structure

The topside module is configured with a steel main column and beam system with braces. External walls and roof areas consist of fully welded steel plates with insulation and finishing on the inside. All rooms are accessible from the external walkways. In addition the external walkways and stair towers form the escape routing. For utility and control facility rooms, access via an internal corridor is provided.

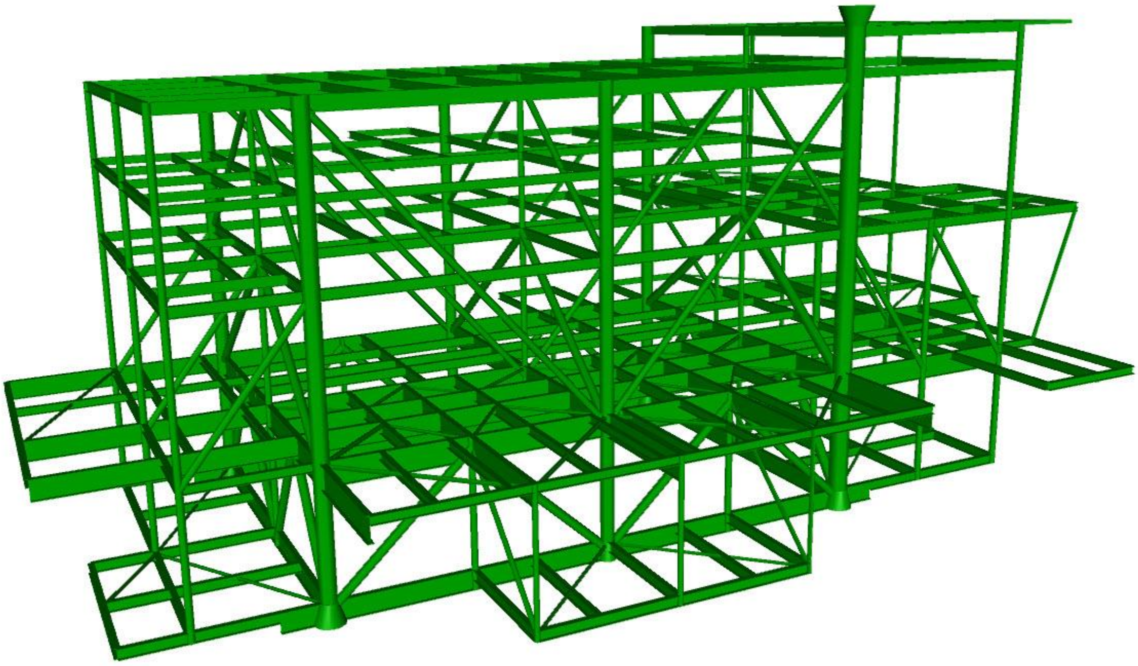

Figure 5-2: Topside steel structure

The topside structure consists of 5 decks (4 ordinary decks and 1 upper roof deck on top of the shunt reactor rooms). 3 sections of the cable deck level will be part of the topside structure.

The topside module has been designed so that the configuration without the two shunt reactors on the north end of the utility deck will not alter the overall structural design.

The HV grid design may see harmonics. In order to filter the harmonics it could be necessary to place HV filter components on the platform. On the roof deck an area shall be reserved for the possible placement of HV filters. For now a weight of 60 tonnes shall be assumed.

5.3 Provisional weight estimate

For jacket and topside the following provisional weight estimates have been established.

Weight break down	mT
Jacket steel structure	2.346
Jacket piles	1.462
J-tubes	574
Topside steel structure	1.615
Topside equipment and bulk	2.006

Figure 5-3: Weight break down

Details on the weights are given in the weight reports ROGE-W-RA-000022 for the topside and ROGE-W-RA-000028 for jacket and J-tubes.

5.4 Field layouts

In the principle field layout the platform is located such that it is surrounded by the two wind park areas. The array cables enter the platform from three sides (north, west and south). The export cables to shore can optimally be connected to the platform on the north side, but connection on the south side will be kept open. The east side shall be kept free from cables on the seabed to secure future accessibility for a jack-up-based heavy lifting crane vessel for potential replacement of a main transformer, auxiliary/earthing transformer or shunt reactor.

The principle field layout of Borssele is shown in:
Field lay-out Borssele Alpha; ONL-TTB-03158
Field lay-out Borssele Beta ONL-TTB-03560.

5.5 Platform Operation modes

In "E6 Operation and Maintenance Requirements, ONL-TTB-03426" [4], the platform operation modes are defined. Separate operation modes are defined for the HV/LV system, Utilities, HVA/C.

5.6 RAM

For design of the auxiliary systems, RAM requirements are given in E2.7; RAM requirements, ONL-TTB-03147.

A very rough assessment of system criticality for the availability of the grid has been made. During detail design, an extended FMECA analysis and a probabilistic risk assessment must be performed to verify that all systems, alone or in combination, will ensure availability of energy supply as specified in the RAM requirements.

Utility system	Critical for availability of energy supply	Mitigation (redundancies/fail mode functions)	Permissible response time in case of a single unit failure
HVA/C, fresh air changes	No	2x50% units 2x100% fans	
HVA/C, chilled water	Yes	(n+1) condenser sections	Less than one week
		(n+1) cooling units	Less than one week
		2x100% circulation pumps	Less than one week
		1x100% piping system	Less than one day
HVA/C, temperature conditioning	Yes	(n+1) room units	Less than one week
Auxiliary Scada	Yes	Fail mode operation	Less than one week
Auxiliary power	Yes	2x100%	Less than one week
Fresh Water	No	100%	
Drain, sewage treatment	No	100%	
Drain, Oil/Water separation	No	100% 2x100% pumps	
Fire Alarm System	No	100%	
Inert Gas system	No	nx100% - dedicated capacity for each covered area	
Foam system	No	1x100% - stored capacity for 1 of 6 areas.	
Diesel generator system (temporary)	No	2x50%	
Platform crane	No	1x100%	

Figure 5-4: Rough assessment of system criticality for the availability of energy supply

5.7 Safety philosophy

Personnel safety is primarily ensured through fast escape and evacuation.

Platform access depends on the workability limits of crew transfer and W2W vessels. This means that the platform can, and will, only be manned in favourable weather conditions. When weather conditions deteriorate, the platform will be abandoned.

A QRA and an EERA have been prepared for the platform. Reference is made to reports ROGE-S-RA-000439 and ROGE-S-RA-000458 respectively.

The EERA demonstrates that personnel on the platform have a good prospect of escaping, evacuating and being rescued in case of an incident on the platform.

Asset protection is ensured by an inherently safe design:

- minimizing the number of systems on the platform (e.g. no permanent diesel generator) minimizes the fire risk
- minimizing the fire load and providing passive fire protection minimizes the need for active firefighting
- residual fire risk has been mitigated by providing water based, air propelled foam and inert gas firefighting systems.

Safety to personnel and the asset shall be further enhanced through dedicated operational and safety procedures.

5.8 Platform access philosophy

The platform is designed for access in two ways.

For regular inspection and maintenance campaigns of limited scope access by CTV is foreseen. Two traditional leg-supported boat landings with ladder access to the landing deck and further stair access to the cable deck are provided. The ladders shall be fitted with a fall prevention system. Davit cranes are provided next to the boat landings for lifting small loads from the CTV.

For more extended visits, or when less favourable weather conditions need to be overcome, a supply vessel can be used which is fitted with a walk-to-work motion compensated gangway system engaging directly to the cable deck. Larger loads can be lifted off these vessels with the platform crane on the top deck.

The platform shall include a helicopter winching area on the roof deck. In case the necessity for emergency-required quick access arises, personnel, injured persons (on a stretcher) and minor goods can be loaded/unloaded. The winch area shall be designed according to CAP 437 requirements.

Unwanted access of the platform shall be prevented by fencing off the boat landing access way at the cable deck entry. If circumstances require so, mariners in distress can access the platform via the boat landing up to the fence on the cable deck where a telephone is provided for making a distress call.

5.9 Waste handling philosophy

There will be no permanent waste storage facilities on the platform. Bins for dry nontoxic and non-emitting waste shall be provided. Containers for wet, toxic and emitting waste shall be used during special operation and maintenance activities and will be stored in the workshop.

When the platform is left, all waste will be collected and brought to shore for controlled disposal.

5.10 Food and drinking water philosophy

Food and potable water shall be brought during manning and removed during demanning.

A dry storage for long time durability goods, emergency rations, will be provided in the public room.

5.11 Mechanical handling philosophy

The mechanical handling provisions on the platform shall make handling of goods and materials possible during all operational modes and during maintenance and repair of systems and equipment on the platform.

The platform crane is the central element in the mechanical handling philosophy. The crane shall be operated from a wireless belly control. This in order to give the operator free sight to any mechanical handling operation from all laydown areas and for loading or unloading from a supply ship. This ship will be positioned at the east side of the platform.

The platform crane capacity shall allow for handling of not less than 5.000 kg from all laydown areas on the platform. The platform crane shall be able to lift the containerised generator and fuel tanks to and from supply vessel and planned location on the roof deck. In case of need for handling of items weighing above the platform crane capacity, handling and lifting capacity will be supplied from special vessels.

Roof decks above the main transformer rooms and shunt reactor rooms and all installations underneath shall be prepared for cut-out of the roof deck and free the opening in case replacement of one of these components is required.

Laydown areas shall be located on each deck level. The laydown areas shall be large enough to accommodate a 10 foot standard container without blocking the doors of the container and the transport routes for handling of tools, spares and other materials.

Provisions for mechanical handling of loads above 23 kg from all laydown areas to and from all the rooms shall be arranged. This includes pad eyes for lifting and or dragging slings, mono rail beams and overhead cranes in GIS rooms.

Reference is made to Mechanical handling plan, ROGE-R-GN-000013.

5.12 Cable pulling philosophy

The platform shall be designed for cable pull-in of array and export cables from the seabed and onto the cable deck. The sea cables shall be routed individually in J-tubes the entire way from the seabed to the cable deck T.O.S. After pull-in of each cable, it shall be fixed in a cable hang-off clamp-on and positioned according to the cable specification.

The platform design shall ensure that all sea cables can be pulled either before or after installation of the topside, without intervening with the pulling methods.

Reference is made to the 3D model for further visual clarification and to drawing no. ROGE-E-XE-000069-00 to see the arrangement of the pulling equipment and the combination of which pad eyes to use for pulling of the various sea cables.

Reference is made to "Cable pulling report", ROGE-Z-RA-000420.

5.13 Maintenance and Spare Parts philosophy

It shall be an integral part of the operation and maintenance strategy to keep the maintenance demanding systems and equipment on-board the platform at a minimum and minimize the number of inspections. Equipment selected shall be simple and highly reliable with a minimum of maintenance required.

During the hook-up and pre-commissioning phase as well as during any major maintenance activities, containers and loose portable equipment shall be taken on-board from the support vessel. This includes for example:

- Office container
- Spares container
- Workshop container
- Rigger container (lifting equipment)
- Scaffold container(s)
- Additional power generator container
- Diesel fuel tank container
- Portable air compressor
- Portable HP water cleaner (200 – 250 bar)
- Garbage Containers

The need of scaffolding during maintenance operations shall be minimised.

Storage area of critical spares shall be provided on board of the platform.

Reference is made to "E6 Operation and Maintenance Requirements, ONL-TTB-03426" [4].

PART 3, FUNCTIONAL DESCRIPTIONS

6. OVERALL PLATFORM

6.1 Room book

The allocation of specific equipment and components to each of the rooms in the platform, as well as the requirements which apply to each of the rooms are all given in the room book; ONL-TTB-00105

6.2 Type approvals

All materials, equipment and systems procured or manufactured by contractor shall be type approved by a recognised approval authority for the intended use, in line with applicable Codes and Standards.

Applicable codes and standards include, but are not limited to the following:

- IEC standards
- type approval standards of classification societies for maritime use of equipment in the shipping or offshore industry
- approval standards of notified bodies, where required by national legislation
- type approval standards by recognised authorities, for application to safety related software systems according to IEC 61508 and IEC 61511, and others
- specific product related standards, such as the VDS (Verband der Sachversicherer) guidelines.

Contractor shall not deviate from this requirement without prior approval from Employer and the Certifying Agency.

7. STRUCTURAL

7.1 Jacket structure

7.1.1 Structural layout

Steel structure with four legs, designed for in-place conditions, barge transport in vertical position and installation by vertical lift onto seabed as one unit by heavy lift vessel. Jacket structure shall have supporting frame for j-tubes and cable deck and pile foundation/pile sleeves on the corner legs with mud mats. The topside shall be supported on six legs.

7.1.2 Boat impact

The jacket shall be designed to resist an accidental boat impact according to NORSOK N-004. Boat size of 5.000 ton displacement is to be used for assessment.

Top of piles shall be below EL. -11.300 MSL in order to allow for safe vessel position at the boat landings.

7.1.3 Grouted connection

Skirt piles shall be connected to sleeves through grouted connection.

7.1.4 Material and fabrication

Material selection shall be according to "Specification for jacket and piles", doc. ROGE-N-SA-000009.

7.1.5 Corrosion protection

Cathodic protection philosophy of jacket shall be implemented in design, according to "Painting and Corrosion Protection Specification", doc. ROGE-N-SA-000010.

7.1.6 Sea access

A primary and a secondary boat landing shall permit sea access of personnel.
The bottom part of the bumpers of the boat landing shall be inclined and curved at the end in order to avoid the vessels to be hooked by the structure during presence of low tide water level.

A suitable fall arrest system, presumed to be an self-retracting lifeline, also known as an 'inertia reel' or 'yo-yo', should be provided on the ladder.

7.1.7 Cable deck

The cable deck shall function as rigging platform during transport and installation of the jacket. The slings and the supports of the spreader bar shall be located on the cable deck. The layout will allow the docking of the topside minimizing offshore works.

After installation of the jacket, the supports of the spreader bar shall be cut-off and ground flushed. The cable deck will be the place of cable pull-in operations before (or after) the topside is lifted on top of jacket.

The cable deck structure shall be designed taking into account the requirement for penetrations of grating and local reinforcements to enable the cable pull-in.

The underside of the cable deck shall be free of the max wave crest of a 10.000 years wave.

7.1.8 Working platforms

Working platforms around the six legs shall be designed so that welding operation of the topside legs will take place after the mating. Access to working platforms from cable deck shall be ensured. After installation of topside is completed, the working platforms shall be removed.

7.1.9 Installation

The jacket shall be lifted from a barge to the seabed by an heavy lift vessel. The lift points shall be located at the top of the four legs and steel fabricated.

The relative displacement between pile and sleeves will be limited by pile grippers during the curing of the grout.

7.2 Topside structure

7.2.1 General structural layout

The topside structure includes 5 decks (4 ordinary decks and 1 upper roof deck on top of the shunt reactor rooms) with the overall dimensions of the primary steel on the main deck of 45.0 x 19.5 m disregarding the external walkways, cooler decks and laydown areas. 3 minor decks at the cable deck level will be part of the topside.

The topside is designed as a braced frame structure with welded I-girders and standard I/H-shaped profiles as primary deck members and circular hollow sections for primary columns and braces. Please refer to Figure 7-1 showing the topside structure modelled in the Smart Marine 3D (SM3D) program.

Bracing/frame structure shall be used as the main load-bearing system.

The topside design consists of two configurations:

- With two shunt reactor rooms
- Without the two shunt reactor rooms.

The necessity of having the shunt reactors installed depends on the location of the platform and the associated length of export cables. Where these cables are relatively short and therefore no shunt reactors are required the shunt reactor rooms can be deleted altogether without further changes to the remainder of the topside lay-out.

For more details concerning topside structure see drawings nos. ROGE-N-GN-000094-01, ROGE-N-XG-000006 (main structure only) and ROGE-N-SA-000001-01.

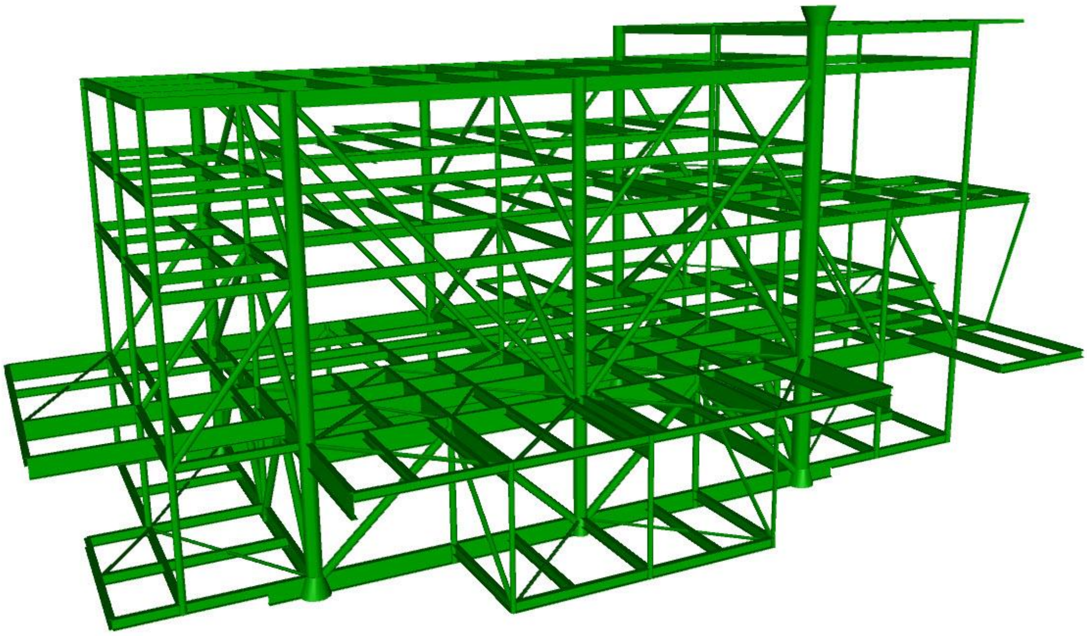

Figure 7-1: Topside steel structure (configuration with two shunt reactors)

7.2.2 Structural calculations

For the topside structure, three analyses have been done as part of the basic design:

- In-place analysis
- Sea-transportation analysis
- Lifting analysis.

For analyses, reference is made to doc. no. ROGE-N-RA-000345 (structural study report).

7.2.3 Deck levels – short description

7.2.3.1 Cable deck, elevation (+) 20.000 T.O.S.

Cable deck area within grid A/1-C/1-A/3 and C/3) is part of the jacket structure.

The remaining part of the cable deck (outside the above-mentioned grid) is structurally connected to the topside structure. These are the deck for sump tank, deck for the two stair towers and the laydown area on the west side. Walk 2 Work landing area on each side of the cable deck shall be included in the design.

7.2.3.2 Main deck, elevation (+) 26.500 T.O.S.

This deck supports the two main transformers with external cooler batteries, the two 66 kV GIS'es, the 220 kV GIS and the earthing/auxiliary transformers.

Floor pits in GIS rooms and penetrations are to be provided to enable connection of the subsea cables to the HV equipment, and for running interconnection cables between the individual HV components. Cable pits shall be minimum 1000 mm deep. Bottom of pits shall be made of stiffened steel plate. After cable installation, the top of pits shall be covered with grating. There shall be access to pits through opening in deck beside the GIS.

Drip trays shall be constructed below all oil filled equipment. Drip trays to be located down between the deck beams. No boundary plate or edge above deck level will be accepted. Drip tray drains to the sump tank on cable deck.

7.2.3.3 Utility deck, elevation (+) 34.000 T.O.S.

At this level, control and protection rooms for 66 kV GIS, 220 kV GIS, LV, shunt reactors, fresh water tank and public rooms are located.

7.2.3.4 Control deck, elevation (+) 38.000 T.O.S.

At this level, the battery rooms, HVA/C rooms, Shared Service Room & Innovation, WPO control rooms, chiller room and workshop are located.

7.2.3.5 Roof deck, elevation (+) 42.000 T.O.S / (+) 44.000 T.O.S.

The roof deck provides a laydown area for standardized containers. It also provides room for containerised diesel storage tanks and diesel generators for temporary use during platform commissioning and for unforeseen black-outs. It shall therefore be provided with standard ISO container lock framing structure with twist locks and lashing points.

On the roof deck an area is reserved for the possible location of HV filters. The HV grid design could cause harmonics which have to be filtered at the offshore platform. The area shall be capable of supporting 60 tonnes in total.

Above the main transformer rooms and shunt reactor rooms soft patches shall be provided to facilitate cut out in case replacement of one of these components should be required. The roof deck in this area shall be strong enough to be used as laydown area.
The roof shall be sloped to avoid water accumulation.

The roof shall be with slope towards east and west from grid line B. Gutters and drains along the two sides to be established.

The roof deck shall be extended towards the North with two dropped object protections above the shunt reactor coolers.

7.2.4 Fire rating for deck areas

The rating for passive fire protection on all deck areas is indicated on Safety plans, ROGE-S-LA-000125.

7.2.5 Structure for major equipment

Generally, below major equipment, I/H-shaped girders are installed as local equipment support and reinforcement of the deck structure. The transformers and the GIS are sensitive to the flexibility of their support structures, and therefore a stiff support structure is required. To obtain a stiff main deck, the topside has been designed with 6 main columns to reduce the free span of the main deck beams.

7.2.6 Structures for mechanical handling and maintenance

Supports for overhead cranes, run way beams, pad eyes for lifting and pulling slings etc. needed for the mechanical handling shall be attached to structural elements. Reference is made to Mechanical handling plan: ROG doc no. ROGE-R-GN-000013.

For external maintenance (e.g. painting repair and cleaning) pad eyes for fastening of scaffolding and rappelling slings shall be attached to the wall structure.

7.2.7 External walls

Horizontal area's in the walls shall be minimized where dirt or/and water pools could form.

All walls inside naturally ventilated rooms, the main transformer rooms, earthing/auxiliary rooms and shunt reactors rooms, are to be considered as external walls.

Wall plates shall be fully welded to columns, braces and deck beams. For natural ventilation in main transformer rooms, earthing/auxiliary transformer rooms and shunt reactor rooms air louvres shall be provided in the lower and the upper levels of the external walls. The louvre panels shall be constructed to prevent ingress to the rooms of rain water and sea spray.

7.2.8 Removable hatches in external walls

For taking out major equipment from the auxiliary and earthing transformer rooms – GIS rooms and Shut reactor rooms, removable wall panels shall be established. The panels shall be designed in such a way that they are water- and air tight, i.e. joints shall be with gaskets, not sealing compound. The panels shall be bolted to the surrounding wall structure with stainless steel bolts. Each panel shall also have two pad eyes for handling.

7.2.9 Internal walls

The inner walls between internal rooms are considered as 'light' non-load carrying walls with the purpose of providing insulation and to provide fire barriers.

Internal walls can be made as IMO or SOLAS certified fire panels (G 21 fire panel system or similar).

7.2.10 Fire rating for internal walls

Fire rating for inner walls can be seen on Fire and Safety plans, ROGE-S-LA-000125.

7.2.11 Antenna tower

On the roof deck at the south-west corner, an antenna shall be installed. The antenna shall carry a revolving radar (21”), a bird radar (12" horizontal, 8" vertical), instrumentation and communication antennas. The tower is supposed to have a triangular shape with an estimated leg spacing of 2000 mm. Open lattice construction on all three sides. Crow's nests for maintenance on all 3 radar beams shall be provided.

An internal ladder with 2 rest platforms and service platforms shall be a part of the tower.

An SRL (self-retractable safety line) shall be installed.

The tower shall be hot dip galvanized before final surface treatment with painting.

It has to be mentioned that the support structure for the antenna tower (at the roof deck) shall be sufficiently rigid to avoid major movements/deflections of the tower. Deflections of the tower shall not disturb antenna signals.

7.2.12 Walkways and stairs

Access walkways and stairs are located outside the topside walls. These areas are designed as open deck structures covered by grating. Laydown areas are integrated into the walkway structure and shall be covered by steel plates to improve the mechanical handling.

7.2.13 Platform crane

The topside will be equipped with a platform crane above the roof deck located in the northeast corner. The crane pedestal shall be designed with tubular-shaped profiles and shall be integrated with the main topside column at the same location. Lifting capacity and range according to crane specification.

The topside module has been designed so that the configuration without the two shunt reactors on the north end of the utility deck will not alter the overall structural design. Only the structures for the shunt reactor rooms will be omitted, and the crane pedestal will be lowered. Figure 7-2 shows the topside steel structure without the two shunt reactor rooms.

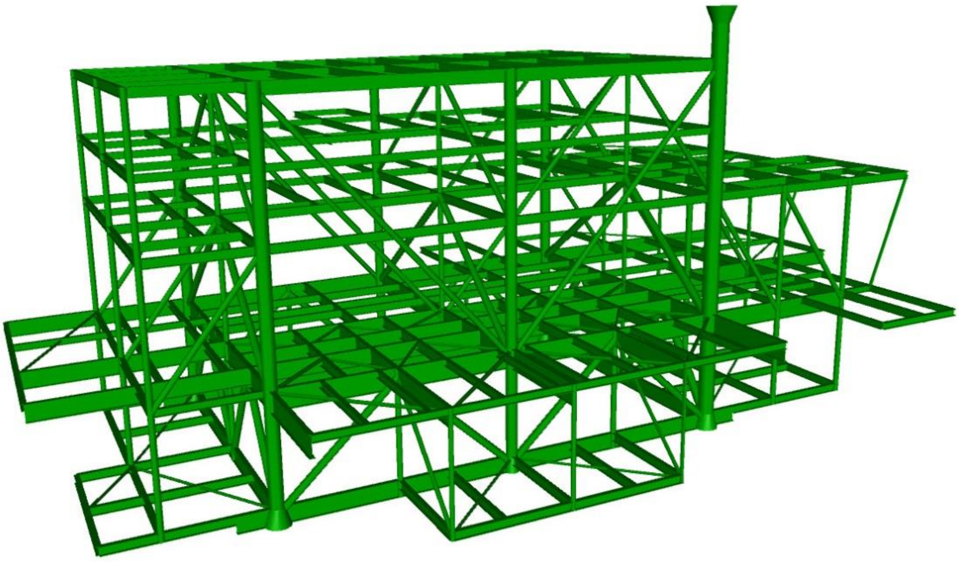

Figure 7-2: Topside steel structure (configuration without the two shunt reactors)

7.2.14 Topside supports on jacket

The topside module is supported by a six-legged jacket structure below the six main columns at grid intersections A/1, A/2, A/3, C/1, C/2 and C/3. The main grid dimensions at the interface to the jacket structure are 28.0 x 19.5 m. Figure 7-3 shows the corresponding base dimensions at the interface level.

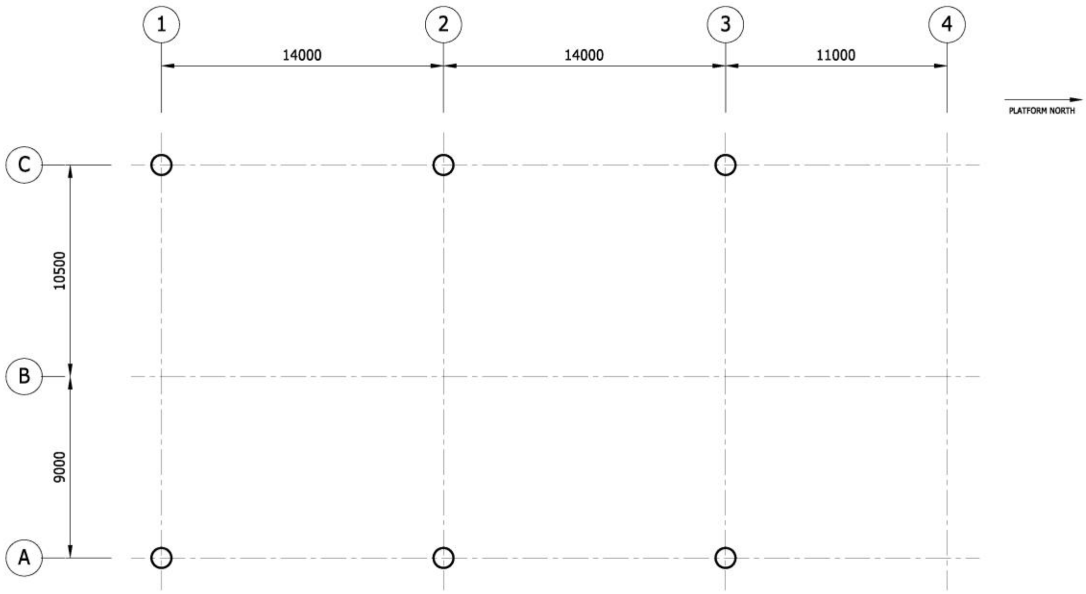

Figure 7-3: Jacket layout at interface level

7.2.15 Fabrication

A conceptual scenario, in which the topside is fabricated on 9 temporary supports, is presented in Figure 7-4 and Figure 7-5. The topside is supported at the hard points, i.e. the 6 main columns and 3 columns in gridline B. The 3 columns in gridline B could be temporary construction supports. These supports will also form part of the sea fastening.

It is assumed that load-out of the platform topside onto the transport barge will be performed by the use of multi-wheel trailers. The trailers are envisaged to lift directly onto these sea fastening supports.

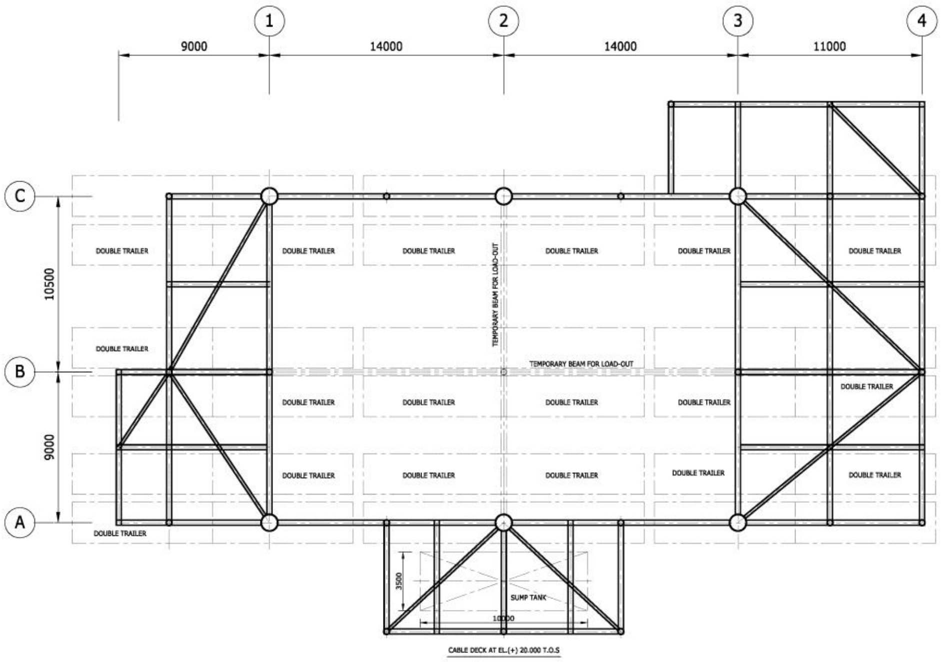

Figure 7-4: Plan view of topside during load out (at cable deck level)

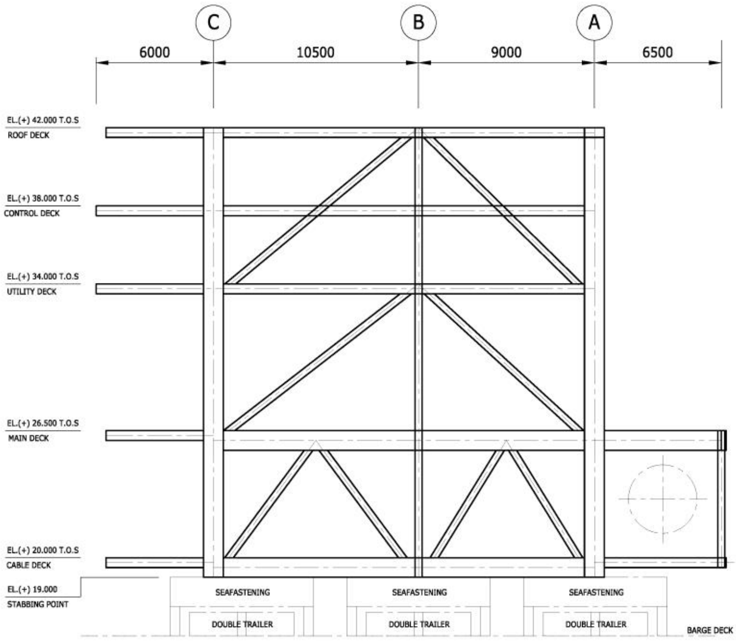

Figure 7-5: Elevation view of topside during load-out (typical for gridlines 1, 2 and 3)

7.2.16 Transportation

It is assumed that the platform topside will be transported on a large cargo barge L > 76 m and B > 23 m. Restricted tow shall be taken into account to reduce the calculated inertia loads in the sea transportation analysis.

7.2.17 Rigging and spreader bar support

During sea transportation the spreader bar shall be supported by two temporary supports on the roof deck.

Furthermore, the wires shall be arranged on a temporary rigging platform built up above the lower roof deck. Estimated size of the rigging platform: 21 x 20 metres.

7.2.18 Installation

The topside lift onto the jacket is assumed to be performed as a 'one hook lift' using a spreader bar. In the design, a topside lift using one installation vessel will be assumed. It is anticipated that lifting of the topside structure is to be designed with 4 lift points at the roof deck level, see Figure 7-6.

The shown lift scenario is independent of the topside configuration, i.e. with or without the two shunt reactor rooms.

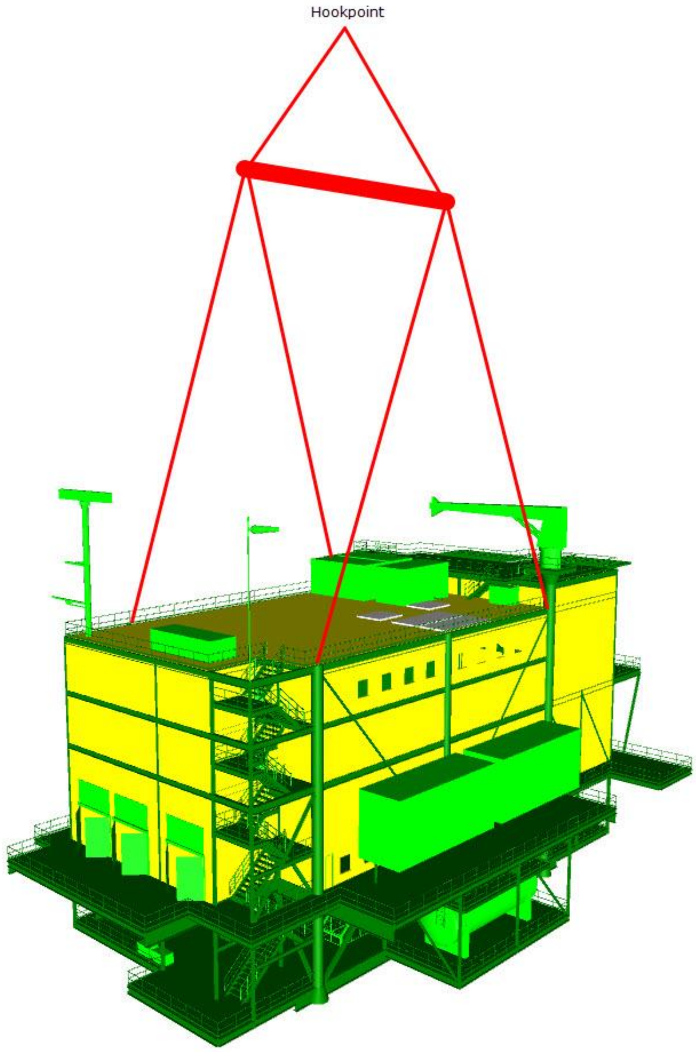

Figure 7-6: Lift of topside with lifting rigging (spreader bar and slings) shown in red

The height of the topside with lifting rigging is assumed to be approx. 71 m, see Figure 7-7. With a stabbing point with the jacket at approx. 19 m above sea level and lift over clearance of 3 m, the minimum required lift height for the topside installation is 71 + 19 + 3 = 93 m.

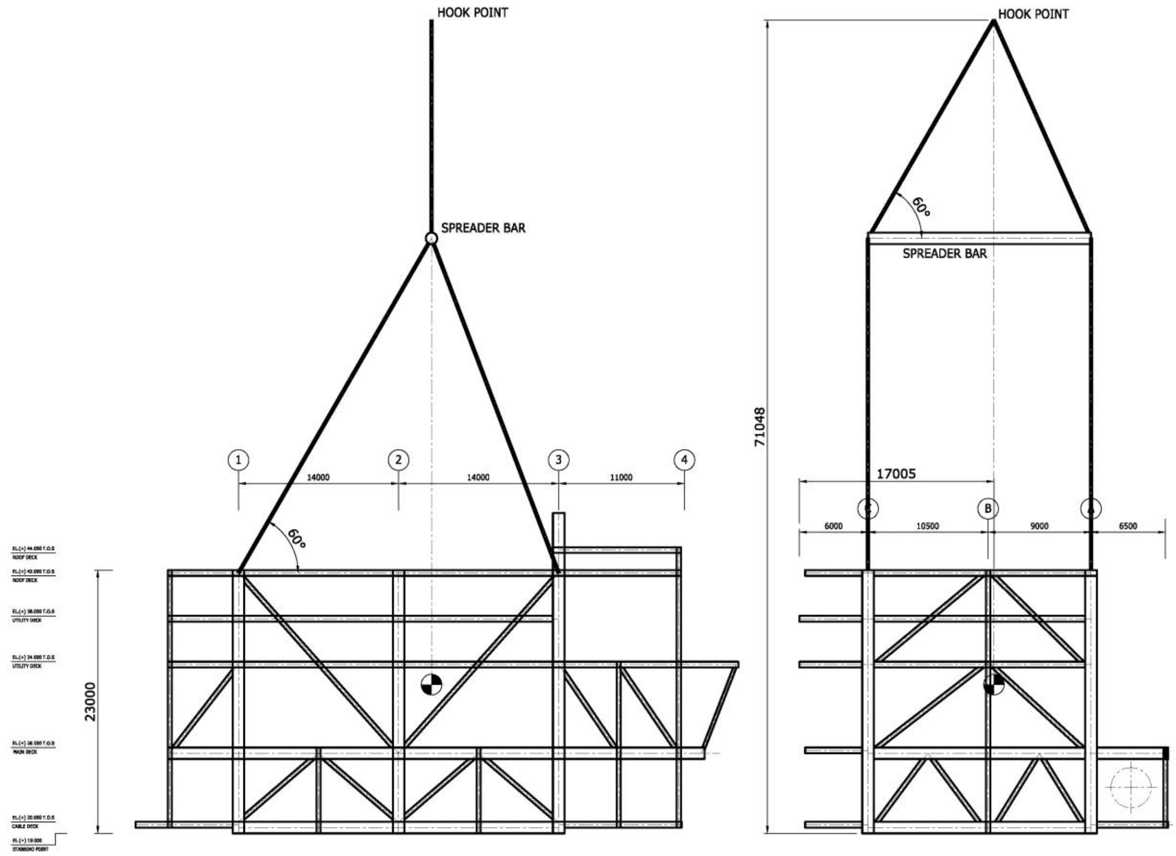

Figure 7-7: Lift height of topside with lifting rigging

An alternative rigging arrangement is shown in Figure 7-8.
The height of the topside with lifting rigging is assumed to be approx. 73 m. With a stabbing point with the jacket at approx. 19 m above sea level and lift over clearance of 3 m, the minimum required lift height for the topside installation vessel is 73 + 19 + 3 = 95 m. The width from lifting centreline is approx. 17 m (distance between vertical centreline at hook point and outermost structure at roof deck) at 47 m above sea level.

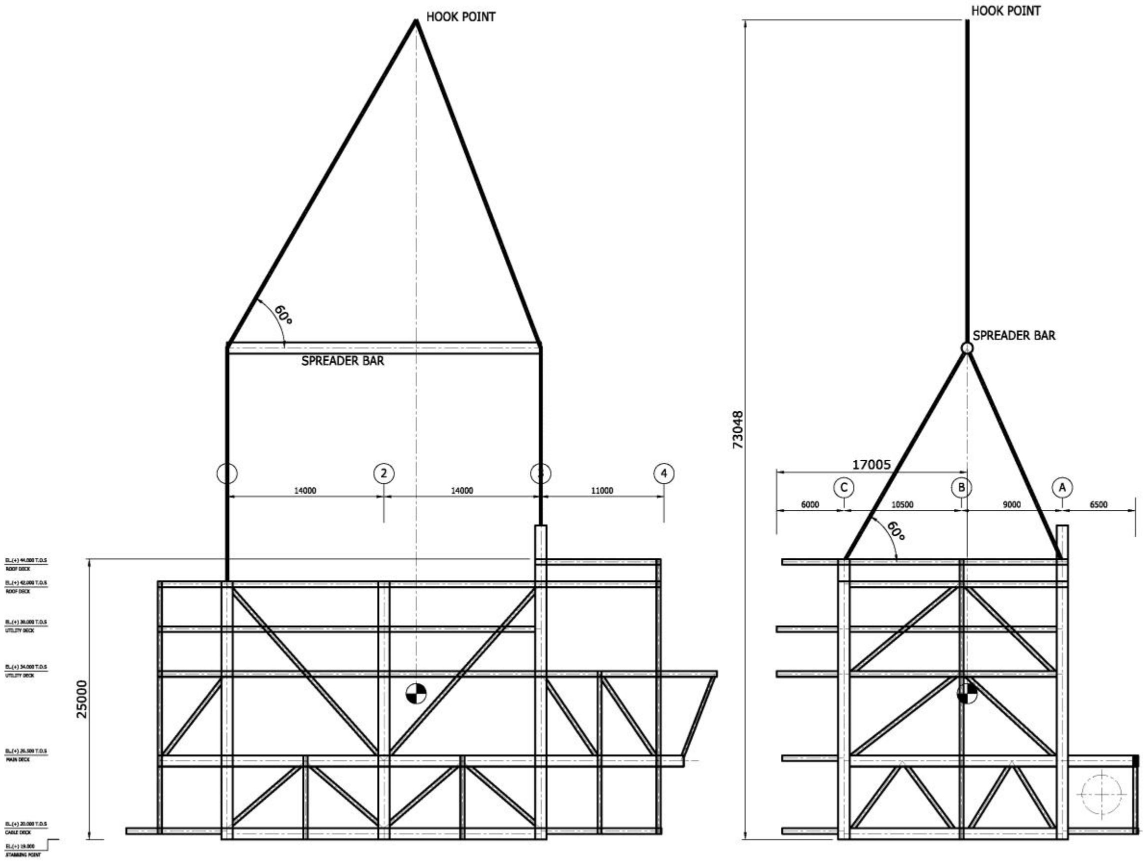

Figure 7-8: Lift height of topside with alternative lifting rigging arrangement

7.2.18.1 Crane vessel capacity

Figure 7-9 shows a typical lifting vessel capacity. At 4000 Mt the max. hook height is 92.82 m and the max. load width is 22 m, 48 m above sea level.

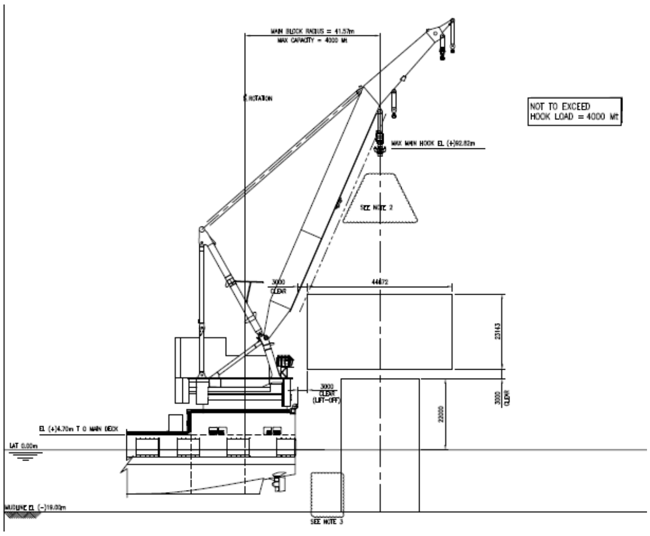

Figure 7-9: Typical lifting vessel capacity

8. ARCHITECTURAL

8.1 General

The architectural design and execution shall comply with: NORSOK C-002, Architectural Components and Equipment.

8.2 Colours for architectural components and systems

All colours shall be in accordance with the architectural colour schedule(s), sample boards in A3 size shall be provided by the Contractor. Employer's standard colour range should, in general, be used.

8.3 Doors

Reference is made to drawing ROGE-N-GN-000094 for door specifications. All doors shall be fire rated according to the wall in which they are located.

External weather tight doors shall be of the hinged type.

No less than 3 hangers shall be fitted to each door blade. Hangers shall be stainless steel, attached on the inside, and maintenance free.

Door coamings as low as possible; ramps to be provided if necessary from transport of heavy equipment on trolleys.

8.4 Lock system

Before handover, all doors shall be fitted with system locks (certified key-based system) prepared for 4 levels of security. Actual security level for each door shall be approved by the Employer.

8.5 Windows

Windows in public rooms (three of) shall be 600x800mm with offshore approved roller blinds.

Windows shall be arranged so that access is possible from the outside for cleaning purposes, or they shall be of hinged type opening inwards.

8.6 Insulation

The thermal insulation, inclusive the complete construction it is part of, shall provide a U-value (heat transmittance) of 0,5 W/m2 °C, or better, for all rooms connected to the HVA/C system.

8.7 Floors

In general steel decks floors are painted according "Painting and Corrosion Protection Specification ROGE-N-SA-000010".

Industrial standard epoxy glued anti-static vinyl sheeting, non-skid type (eg. Bolidt/Solvolan floors) shall be applied in:

- Change rooms
- Public Room (Mess)
- Store
- Toilet(s)
- Shower
- Corridor(s)
- Control Room(s)

The sheeting shall be applied fully welded and continue 150 mm up on the segregating walls.

Reference is made to ROGE-N-GN-000094 for specifications for grated and plated decks.

8.8 Walls

For all closed rooms, walls shall be fully insulated from floor to roof.

The insulation to be designed to fully prevent condensation in any part of the construction. The construction, including interfaces to floors, roofs and penetrations, shall provide a vapour diffusion resistance of not less than 50 GPa s m²/kg.

Two types of internal room side surface finish shall be applied:

- Type I: Industrial finish; Panel cladded on the room side with 1 mm AISI 316L plating (minimal 3 m from floor level).
- Type C: Comfort finish; Panel cladded on the room side with galvanized steel covered with PVC decorative foil or coated.

Required wall types are indicated in the Room Book, ROGE-Z-LA-000247.

8.9 Ceiling

False ceiling shall be 600x600 mm standard system. The panels shall be removable without use of special tools.

False ceilings shall be applied in the following rooms:

- Change rooms
- Public Room (Mess)
- Store
- Toilet(s)
- Shower

8.10 Inventory Public rooms

Public room areas shall be fitted (in sufficient quantities for 12 POB) with:

- Pantry with:
  - Stainless steel counter with a double sink and drawers for cutlery
  - Stainless steel cupboards
  - Water boiler
  - Microwave
  - Refrigerator/freezer
  - Coffee and tea making facilities
  - Drinking water tank fixture
- Living area with:
  - 2 eating tables for 6 persons each
  - 12 chairs
- Storage room with:
  - 800x400x2000 mm shelf sections with 5 shelves along 3 sides
- Locker rooms, Men:
  - 12 steel lockers 300x400x2000 mm
  - 2 500x400 wash basins with fixtures
- Locker rooms, Women:
  - 4 steel lockers 300x400x2000 mm
  - 1 500x400 wash basin with fixtures
- WC:
  - 1 500x400 wash basin with fixtures
  - 1 WC
  - 1 Urinal
- Shower
  - 1 800x800 shower area with fixtures

The workshop shall be fitted with:

- One workbench with 8 drawers and extraction hood
- Storage cabinets for tools
- One (1) sink with hot/cold water faucet
- One (1) pegboard behind the workbench
- One test board with test sockets for each voltage range (400/230V 50 Hz, 110/48 DC), rotary field meter, constant current source min. 0-20mA, adjustable resistance, adjustable DC voltage source (min. 0-12 V), AC voltage source (0-250 V) and continuity tester with buzzer
- Digital multi meter, suitable for all platform-related testing
- Digital oscilloscope with recording facility (USB), suitable for all platform-related testing
- 6 m² rack for small items with fully transparent cover
- Storage cabinets for electrical tools and components
- Standard toolset (screwdrivers, wrenches, drill etc.)
- Storage for:
  - High Pressure water cleaning units.
  - Loose Material handling equipment
  - SF-6 equipment (dilo-car)

8.11 Waste handling equipment

In control rooms, the workshop and public rooms fixtures for collection of waste shall be available. Additionally two mobile fixtures will be placed in the workshop.

The fixtures shall be heavy duty industrial standard fixtures for soft plastic inserts. The fixtures shall provide solid support and protection for all sides of the inserts.

Scope of waste collection fixtures shall be:

- Public rooms and workshop: 60 litres per room
- Control rooms: 1x30 litres per room
- Mobile fixture : 2x60 litres.

8.12 Hazardous Material Storage

Facilities for storage of hazardous materials shall include:

- A bounded area with drain system for storage of 4 x 60 litres oil drums.
- An ATEX cabinet with constant exhaust for storage of chemicals, paint and similar materials.

These storage facilities shall have drip trays connected to the oil drain system.
SF6 bottles will be stored in the GIS rooms. Provisions to store SF6 bottles shall be provided.

8.13 Bird fouling prevention

To prevent bird access to areas with sensitive equipment and to prevent excessive fouling of the topside the following areas shall be closed off with bird netting:

- the cable deck area framed by grid lines A, C, 1 and 3
- the cooler batteries for main transformers
- the cooler batteries for shunt reactors

The bird nets shall be made of stainless steel net with 25 x 25 mm mesh size, supported by stainless steel framings attached to the topside structure or by light weight vertical GRP grating.

In places where the bird net will be crossing walkways and escape routes, gates with the same construction as the net itself shall be installed.

8.14 Spare part storage

Spare part storage will be in the workshop and the spare room/store room at the main deck.

8.15 Marking system

Passage ways/routes on open deck or in equipment rooms which will be predominately used shall be marked by boundary stripes.

9. SAFETY

9.1 Escape, evacuation and rescue equipment

9.1.1 Muster area

Two muster areas shall be arranged on the cable deck. Both muster areas shall be fitted with a safety evacuation system (chute evacuation system) to access the life rafts.

9.1.2 Hospital, first aid equipment

The public room will serve as wait and treatment area until evacuation is possible. First aid equipment including an AED will be stored in the public room.

9.1.3 Life Saving Appliances

Lifesaving equipment shall be provided for maximum POB (12 persons).

The following lifesaving appliances shall be installed:

- Two life rafts at each muster area (i.e. 4 in total) on the cable deck including descent system (chute).
- Semi-automatic life jackets and survival suits are to be stored inside a locker at the muster station(s) next to the life rafts.
- A sufficient number of life-buoys with lights are to be arranged along the outer railings.
- Sufficient manual safety equipment shall be installed according to DNV-J-201.

Reference is made to the Specification for Life Saving Equipment ROGE-S-SA-000084 and the safety plans ROGE-S-LA-000125.

9.1.4 Emergency shelter

Provisions for personnel unexpectedly being stranded on the platform and not able to leave shall be provide (E.g. stretchers, sleeping bags).

9.2 Fire alarm system

The platform shall be equipped with fire detection alarm system. The fire detection system shall detect fires indoors and outdoors and activate respective alarming, i.e. audible and visual alarms.

The automatic fire detection system cabinets shall be located in the TenneT Control Room. In the fire alarm system cabinet, a status display shall be installed and access to local resetting of the fire alarms shall be established.

The system is to be addressable with a double loop, i.e. every addressable detector communicates with the central from both sides of the loop. If a fire or a short circuit should occur in the cable, all detectors will remain active and an alarm will indicate the error between the detectors concerned.

The fire alarm system logic shall be documented on cause and effect diagrams showing each input and its action on all outputs. Detailed Design Cause & effect diagrams shall be prepared by the Contractor. For Basic Design cause & effect diagrams reference is made to doc. ROGE-S-XR-000001.

The functional requirements and design philosophy of the fire alarm system are specified in the specification for the fire alarm system. Reference is made to ROGE-S-SA-000083.

9.3 Active fire protection

9.3.1 Foam firefighting system

Foam systems shall be used for active firefighting in rooms and areas with oil containing equipment (earthing/auxiliary and power transformers, shunt reactors). Upon fire detection, the foam system will automatically release and totally enclose and extinguish the fire.

9.3.2 Inert gas

Inert gas firefighting systems shall be used in rooms with electrical and mechanical equipment not containing oil. Upon fire detection, the inert gas will automatically release. The inert gas will extinguish the fire by reducing the oxygen content in the room. Notification to leave the room before release will be given.

9.3.3 Manual fire extinguishing

CO_2 fire extinguishers for manual fighting of fires will be stationed in rooms and areas as shown in the safety plans ROGE-S-LA-000125. Powder based manual fire extinguishers will not be allowed on the platform.

9.4 Passive fire protection

Passive fire protection is provided by fire rating requirements to walls, decks and doors as shown in the safety plans ROGE-S-LA-000125.

10. AUXILIARY POWER

10.1 General

This section defines the basic requirements for the electrical LV systems to be designed for the standard 700MW AC offshore substation. The following topics will be described:

- LV power system
- Platform lighting and small power
- Earthing and bonding
- Lightning protection
- Cable types and cable ways.

This section has to be read in conjunction with:

- Technical Specification Electrical Switchboards; ROGE-E-SA-000009
- HV/LV Block diagram; ROGE-E-XX-000064-01.
- Specification, Earthing, Bonding and Cable ways; ROGE-E-SA-000011

10.2 LV power system

The LV power system is obtained from the two 66/20/0.4kV auxiliary transformers, which are supplied by the 66kV transmission system. Power may be fed from the grid or via power link from an adjacent platform (if present). LV power can also be supplied by temporary diesel generators which can be placed on the roof deck.

The platform LV power distribution is divided into two fully separated sections by means of interlock functions, which means that it will not be possible supplying from one site to the other side when both auxiliary transformers are online; only when one auxiliary transformer is offline, it is possible to connect both main switchboards with each other via the tie line.

On the LV single line diagram ROGE-E-XJ-000012, the electrical power distribution system for the platform is shown. In the top of the single line diagram, the auxiliary transformers are shown from where electrical power cables are to be routed to the main switchboards, and from there distributed to UPS systems, HVA/C, diesel generators, minor distribution boards, and various other equipment.

A preliminary load list is shown in ROGE-E-CA-000181.

10.3 Back-up power supply

During normal operation of the platform, there will be no diesel generators present. Hence, if a loss of main power occurs and cannot be re-established within the battery back-up time of the UPS systems, a diesel generator shall be shipped and installed on the platform roof deck in order to perform a black start operation. As in such case no power will be available for the platform crane, the supply vessel shall temporarily supply the dedicated crane switchboard via a cable connected to an outlet near the boat landing area. When the crane is up and running, the crane lifts up the diesel generator located on the supply vessel. After re-establishing the power connection to shore, the generators can be removed from the platform.

During the commissioning phase the diesel generators will be the primary power source as no other cable connection to shore or other platforms will have been established yet. The diesel generators will be placed and installed already in the yard and connected to the main switchboards.

10.4 UPS systems

The UPS system consists of two independent 400/230VAC UPS systems and two independent 110VDC UPS with dedicated distribution panels. The UPS systems is configured redundant with 2x100% sides, each with 2x50% battery banks.

The AC UPS system provides power for servers and cabinets located in the control rooms and provide power for emergency lighting and other essential equipment required to be supplied from UPS. The battery back-up time is 10 hours. All consumers from the AC UPS systems shall be redundant supplied with a feeder from each UPS sides. Lighting fixtures however, shall be appropriate divided between the various distribution boards in order to avoid "low lux" areas if a breaker trips.

The 110VDC UPS system provides control voltage for critical GIS protection & control systems on the platform. The DC UPS systems shall account for large motors and trip coils in the GIS equipment. All consumers from the DC UPS systems shall be redundant supplied with a feeder from each UPS system.

This section should be read in conjunction with:
Technical Specification UPS systems; ROGE-E-SA-000010.

10.5 Platform lighting

The general platform lighting shall only be switched on when the platform is manned during visits. A control box with on/off push-buttons lighting control and indication lamp for switching off the lighting shall be located at the platform access areas. Emergency lighting fed via UPS shall be switched simultaneously with normal lighting, and also only be switched on during manned operation. The lighting system shall be designed in accordance with lux levels provided in Room Matrix [9]. Outdoor lighting shall be controlled by a twilight sensor.

10.6 Emergency lighting

UPS supplied lighting fixtures shall be used for safe evacuation in emergency situations or when normal power supply is down.

10.7 Small power supply

Power outlets shall be applied for various purposes on the platform and shall be of type 3 pol for 1-phase, neutral and earth installations and type 5pol for 3-phase, neutral and earth installations. Power outlet shall be supplied from normal powered switchboards.

Power outlets shall be available in all rooms and on strategic locations outside.
The number and type of outlets is listed in the room book.

Outdoor socket outlet assemblies shall consist of:

- 1 x CEE outlets 400 VAC/63A
- 1 x CEE outlets 400 VAC/32A
- 2 x CEE outlets 400 VAC/16A
- 4 x outlets 230 VAC/13A.

All power outlets and socket outlet assemblies shall be double isolated. Material shall be industrial strength, UV resistant, plastic.

10.8 Heat tracing

Piping, instrument tubing, vessels and instrument connections, which can potentially be blocked by freezing water, shall be heat traced and insulated. The drain piping system shall be designed with slope, and therefore no heat tracing is required. The heat tracing shall only be powered when required either by location or process conditions. The heat tracing shall be self-regulating.

11. UTILITY SYSTEMS

11.1 General

The platform shall be provided with the following utility systems:

- Drain systems
- Fresh water and Potable water system
- HVA/C system
- Diesel generator system.

Reference is made to utility flow diagrams, ROGE-P-LA-000608 and functional P&IDs, ROGE-P-LA-000597.

11.2 Piping

The following systems require piping:

- Hazardous drain systems (O)
- Hazardous drain systems (O/W)
- Drain to sea systems (W)
- Black/grey sewage drain systems incl. overboard caisson
- Fresh water system
- Fresh water bunker line
- RFU closed cooling circuit
- Chilled water circuit
- Fuel systems
- Firefighting system foam
- Firefighting system gas

Reference is made to Piping specification, ROGE-L-SA-000036.

11.3 Drain systems

Drain systems includes the required installations for:

- Hazardous drains for oil
- Hazardous drains for oil/water
- Drain for black and grey sewage water.
- Drain for clean water

The sump tank shall collect all hazardous drains. The sump tank shall have two sections. An oil section and an oil/water section. Oil/water drains shall be connected to the oil/water side. From here the collected fluid shall be pumped to an oil/water separator. Separated oil fractions shall go to the oil section and the clean water fractions shall be discharged to sea. Oil drains, chemically contaminated drains and the work shop wash basins drain shall go directly to the sump tank oil section. Upon high level in the oil side of the sump tank, notification for emptying the tank shall be given. The sump tank content shall be emptied via hose connection to bunker vessel and transported to shore for controlled treatment.

Operation of oil/water separation and level measurements shall be automatically controlled by the auxiliary SCADA system.

Black and grey sewage water shall be Broyeur treated before let submerged to sea via a dedicated dump caisson.

Clean water drains (rain and cleaning water) shall be collected and let directly overboard.

Reference is made to Specification, Drain systems, ROGE-P-SA-000003.

11.4 Potable water

Water for drinking and cooking shall be supplied manually during manning mode. Dispenser to be located in public rooms.

11.5 Freshwater system

With the freshwater systems, water of non-drinking quality shall be stored and provided for cleaning purposes.

Freshwater shall be bunkered from ship via hose connections from the bunker connection station on the main deck and stored in a tank. From here, freshwater is distributed to the tapping points.

For external cleaning, tapping points shall be arranged for reach of all surfaces with mobile high pressure cleaning units.

For tapping in public rooms and in workshop, tapping points shall be arranged for wash basins, WC and shower. Wash basins and showers shall be provided with cold and warm freshwater. Warm freshwater shall be generated locally by electrical water heaters.

Tapping points shall display signs "no drinking water".
Reference is made to Specification, Freshwater systems, ROGE-P-SA-000002.

11.6 HVA/C system

The HVA/C system shall maintain required conditions for all rooms on the platform.

Fresh air supply
One or two central air handling units shall provide fresh air to all closed rooms. Water, salt particles, dust and humidity shall be separated from the ambient air before inlet to the rooms. Furthermore, the inlet air shall be pre-temperature conditioned by heating or cooling.

Pressure control
Air outlet from the ventilated rooms shall be controlled by pressure relief dampers keeping the required overpressure in all rooms. Local exhaust fans shall be provided where required to removal of fumes or gasses (battery rooms and workshop) or for purging purposes (GIS rooms).

Room temperature control
Heating or cooling capacity for temperature control in rooms shall be provided by local fan coil units. For rooms with no cooling capacity requirement, heating capacity shall be provided by air inlet duct heating elements.

Heating
All heating elements in the HVA/C system shall be electrical.

Cooling
Cooling for the HVA/C system shall be provided by a central mechanical cooling plant for chilled water production. The central cooling plant shall be modular n+1 configured designed for ‘plug and play’ exchange of cooling units. The coolant medium shall be approved for use for the lifetime of the platform.

The chilled water shall be mixed in a buffer vessel for good temperature control. The chilled water system shall have 2x100% pumps. All chilled water consumers shall be connected in parallel and include isolation valves.

The cooling units shall be cooled by a separate closed cooling circuit with an external located dry cooler. The dry cooler shall be modular n+1 configured.

Reference is made to Specification, HVA/C systems, ROGE-R-SA-000066.

11.7 Diesel generator system

The platform shall have facilities to accommodate two mobile diesel generators and two diesel fuel storage tanks to provide temporary power. In total four fuel tanks shall be provided. Two additional fuel storage tanks shall be provided to be able to exchange the fuel tanks for onshore refuelling.

The mobile diesel generators and diesel fuel storage tanks will be shared between the offshore substations. Two mobile diesel generators and four tanks shall only be provided for Borssele Alpha.

During the commissioning phase the diesel generators will be the primary power source as no other cable connection to shore or other platforms is available.

When the 66kV link cable to the Beta platform is in operation the mobile diesel generators shall be removed from the platform and stored onshore. The 66kV link cable will provide emergency power.

In case of a complete loss of power, no power from shore and no power via the 66kV link cable, the mobile diesel generators shall be shipped and installed on the platform roof deck in order to provide temporary power to the platform and to facilitate a black start operation.

The output of one mobile diesel generator unit shall be sufficient to cover the base load of the platform excluding the crane. The second mobile generator will be standby and shall be capable of supplying the main platform crane.

Generator sets and fuel storage tanks shall be built in a standard container prepared for fastening to container foot framing on the roof deck. All units shall have ‘plug and play’ connection to the platform power and control systems.

The diesel generators and fuel tank shall be connected to the Auxiliary SCADA system for remote monitoring and control.

Reference is made to Specification, Diesel generator systems, ROGE-P-SA-000004.

12. MATERIAL HANDLING

The platform shall be provided with the following equipment for material handling.

Reference is made to Specification, Crane, ROGE-R-SA-000064 and to Specification, Hoists and lifting materials, ROGE-R-SA-000065.

12.1 Platform crane

The platform shall be fitted with a main platform crane, operated with a wireless belly control from any position of the platform.

The crane shall have minimum 5.000 kg lifting capacity from any laydown area on the platform and from supply ship located on the east side of the platform.

The platform crane capacity shall be able to lift the diesel generator and the fuel storage tank.

12.2 Overhead cranes

Three overhead cranes for handling of loads during operation, maintenance and repair shall be applied in the GIS rooms. The crane capacities shall be:

- 66 kV GIS rooms (two): SWL 2000
- 220 kV GIS room: SWL 2500

12.3 Davit cranes

Two electric driven Davit cranes shall be applied on the main deck for handling of light loads to and from crew transfer vessels, while located at the two boat landings. The davit cranes shall have facilities for manual operation during black start up.

12.4 Lifting and hoisting equipment

The material handling philosophy is based on requirements to have facilities, by means of mechanical lifting equipment, to lift and transport equipment/object weighing 23 kg or more.

There shall be enough space for the use of lifting and transportation gear, where lifting or transport of more than 23 kg is required.

Permanent arrangements (e.g. monorails, pad eyes, cranes and temporary lifting arrangements) shall be installed for material handling of equipment/objects > 200 kg and which require regular maintenance, if not reachable by movable lifting appliances.

The minimum requirements for material handling of equipment is given in the table below.

	Maintenance interval		
Weight	**Yearly**	**2-4 years**	**>4 years**
23 - 200 kg	A	B	C
200 kg – 3 tonn	A	B	B
>3 tonn	A	A	A

Table 1 Requirements for material handling

Key
A Permanent installed lifting arrangements, e.g. monorails/padeyes.
B A documented description (material handling report) for material handling of equipment with use of temporary lifting equipment. The plan shall include documentation of structural capacity of all lifting points of more than 200 kg.
C No requirements for documentation of material handling.

13. INSTRUMENTATION AND COMMUNICATION

13.1 Instrumentation

All measuring instruments shall generally be installed as near as possible to the point of measurement. Transmitters and indication gauges shall be installed with isolation valves (block and bleed) for maintenance purposes.

Hardwired signals shall only be used where interface via Ethernet/IP cannot be achieved.

The systems shall be connected via redundant auxiliary SCADA network. Few signals between the systems shall be hardwired. To minimise cabling between the equipment and central control system, RIOs shall be used.

Priority settings for hardwired signals are:

- Indications
    1. Double indications
    2. Fail safe single indications
    3. Single indications
- Commands
    1. Double commands
    2. Single commands
- Signal voltage is given from the system, which acquires the indication. Indications are potential free contacts – either open or closed. Commands are given as pulses via potential-free contacts. Analogue signals may not have common returns.

Instruments and equipment interface with the auxiliary SCADA system shall be configured with the direct interface of fieldbus devices. Only special instruments that cannot be directly connected to the fieldbus can be connected as 4-20 mA DC analogue signals.

Electrical power for instruments shall be supplied from two independent sources to provide the highest possible reliability. The supplies shall be provided from the UPS system. All instruments shall be loop powered.

Electronic transmitters shall have external access for zero and span adjustment. Transmitter accuracy shall be equal or better than ± 0.25%. All transmitters shall be provided with integrated local indication.

The status of all actuated process valves need to be signalled to the auxiliary SCADA system.

Status and control signals shall be digital signals at the same voltage level as the SCADA main supply.

Alarms and other real-time data communicated to the auxiliary SCADA systems shall be done by using a standard IEC protocol in accordance with IEC61784 and IEC61158 or hardwired signals.

13.1.1 Temperature and humidity

Temperature and humidity sensors shall be installed in each room and used for monitoring and HVA/C control.

13.2 PA/GA system

The Public Address/General Alarm system shall provide audio coverage for voice and alarm signals on the entire platform. It shall be possible to make announcements locally or from the onshore control room via VoIP.

The loudspeakers have to be distributed on A and B loops, and as a minimum there shall be separate A and B loops for internal areas, and A and B loops for external/outdoor areas.

The main equipment shall be located in a separated A and B cabinets located in the TenneT Control room.

For reference see ROGE-T-SA-000006.

13.3 CCTV system

The CCTV installation shall provide visual supervision of all critical and hazardous areas on the platform from remote locations.

The CCTV system shall be based on the network and cabling provided as part of the IP services network, hence the deliverables for the CCTV system on the platform is the IP cameras with needed accessories and patch cables.

On the onshore substation a Server and Network Video recorder shall be installed in a IT cabinet.

The CCTV system will be connected to the Aux SCADA system via IP to enable SCADA operators to survey locations where alarms are activated automatically.

For reference see ROGE-T-SA-000007.

13.4 Navigation aids / Aviation lights

Navigation aid is required to ensure clear and unambiguous marking of waterways for safe navigation, to protect the platform and to protect the environment.

Aviation obstruction light is required to ensure safe navigation if an helicopter evacuation is required. The aviation obstruction light is high-intensity lighting lamps attached to tall structures such as antenna masts and cranes, and is used as collision avoidance measures.

Navigation aids, aviation lights and platform marking shall be subjected to approval by the relevant authorities.

For reference see, ROGE-T-SA-000008.

13.5 FOG Horn

A fog horn shall be installed on the platform, the fog horn shall send out the Morse code "U" and automatic start and stop if the visibility is below 2 Nautical miles. Sound level of the fog horn shall be according to IALA E109. Putting into operation the fog horn shall be preceded by an audible notification throughout the platform.

13.6 Telephones (VoiP)

VoIP telephones shall be installed throughout the platform, the telephones shall be used for access control, emergency communication and general communication from all necessary working locations. The VoIP telephones shall be integrated with the employers call manager system located onshore via PoE switches installed as part of the IP Services.

For reference see specification for IP Services, ROGE-T-SA-000004.

13.7 Third Party Equipment, Shared Services (RWS).

On the platform various sensing and communication systems will be provided as free issued material. The equipment will be supplied via a third party named RWS. The systems are described in a separate document: Scope of work & Functional Requirements – Free Issued Materials (RWS), Shared Services; ONL-TTB-03146

These systems include:

- Meteo Measurements System (AWOS)
- Hydro Measurements System
- VHF Radio including RoIP (Radio over IP)
- AIS Base station
- Digital Selective Calling, (GMDSS)
- Maritime Radar
- Bird Radar
- Bat detection
- LoRa Gateway
- NETPOS station
- Communication Base Transceiver Station
- and the associated data gathering and telecommunication systems.

14. SCADA AND NETWORKS

14.1 Networks

The platform shall be provided with the following networks:

- Power SCADA network
- Auxiliary SCADA network
- IP services network. Including the VoIP and CCTV systems
- Out of Band network
- Internet network, Including WI-FI
- WPO network,
- Shared Service network (RWS)

On the platform there are two separate SCADA systems. The Auxiliary and Power SCADA system. The Auxiliary SCADA system controls and monitors all auxiliary systems (non HVAC systems). Data exchange between the two SCADA systems on the platform need to be avoided.

All communication shall be via single mode fibre optical cables in the HV submarine cable.

The current estimation for the number of cabinets is:

- 2x3 cabinets bayed together for ODF, IT Equipment and CDF
- 2x1 for PA/GA system
- 2x1 for future use.

The scope of the telecommunication networks ends at the cabinets in the land station. Therefore The contractor shall design, supply and deliver cabinets to the onshore substation, the cabinets shall be configured as an A and B side containing a cabinets for the optical distribution frame and a cabinet for IT equipment, the cabinets shall be bayed together to enable direct access between cabinets.

14.1.1 Power SCADA

The power SCADA system controls and monitors the HVAC equipment. Due to the interdependencies between the HV system on the platform and the land station the system will be procured separately and delivered as free issued material to the Contractor. For further information about the Power SCADA see: HV Control Philosophy, ONL-TTB-03154

14.1.2 Auxiliary SCADA

The Auxiliary SCADA system controls and monitors all auxiliary systems (non HVAC systems).

Operation and control of the standard platforms will primary be performed onshore; however, a local HMI station offshore is required for use in manned mode. All the statuses, settings and data of the auxiliary systems shall be made available to the HMI onshore and offshore. Local panels and controls shall be kept to a minimum and are only allowed when the complete functionality of is also available to the Auxiliary SCADA.

Local control panels shall have an interface to the Aux SCADA system. Furthermore, they shall be connected via ethernet network to enable remote access for specific maintenance purpose.

The auxiliary SCADA systems need to operate automatically and stand-alone.

The system shall be maintainable and segmented appropriately, allowing a broken element to be quickly identified and repaired while leaving the balance of the system available. This also means the system shall be have flexibility to allow for ongoing modifications without disruptions to operation. It shall be possible to put offline the Aux SCADA system without a complete platform shutdown.

The number of cabinets, for the auxiliary SCADA system located inside the control room, is estimated to three cabinets. This is based on the hardware requirements and a preliminary field I/O estimate based on P&IDs, UFDs and/or the Room book. The number and location of RIOs shall be estimated by the contractor.

The basic design of the control and instrumented systems is shown in drawings no. ROGE-I-XI-000039, topology diagram and ROGE-I-XI-000040, interface block diagram for the auxiliary SCADA system. The requirements for the auxiliary SCADA are defined in the auxiliary SCADA system specification, doc. no. ROGE-I-SA-000005.

14.1.3 IP services network

The Contractor shall deliver IP services network consisting of the structured copper cabling for all ethernet base connections and dedicated switches for data to the Employers network i.e. VoIP, CCTV and access to web interfaces of PA/GA, CCTV, servers etc.

The structured LAN cabling shall be built on Cat.6A cabling or better. All cables shall be terminated in patch panels inside cabinets and wall outlets in the field.

The number of patch panels and their location shall be chosen so that copper cables do not cross the large transformers, and at the same time reassure redundancy.

The LAN installations shall cover all rooms and areas on the platform. As a minimum, RJ45 outlets shall be installed for the following functions and equipment:

- Voice over IP (VoIP) telephones
- Rectifiers and inverters
- Diesel generator(s)
- HVA/C systems
- CCTV system
- PA/GA system
- Other fixed systems
- NAVAIDS

The RJ45 outlets for fixed equipment shall be located in the panels within shot distance to the equipment. Whenever a piece of equipment is dedicated to a LAN outlet, it shall be stated on the layout drawings.

14.1.4 Out of Band network

The Out of Band network shall be established on the platform as an independent network enabling direct access to all IT equipment via the ILO port, hence enabling IT to provide Out of Band support if main equipment or communication routes fails.

14.1.5 Internet network

The internet network shall be established on the platform covering the complete platform, including outside areas. The network consists of the WI-FI network and dedicated outlets.

The internet access is supplied directly from an internet service provider and shall be routed via dedicated firewall, routers and switches.

For reference see ROGE-T-SA-000004.

14.1.6 WPO network

Wind Park Owners will establish a separate SCADA and telecommunication network to operate the wind park. Fibre optics, patch panels, and patch cables to be provided as shown in ROGE-T-SA-000005.

14.1.7 Shared Services network (RWS).

RWS will establish their separate SCADA and telecommunication network to operate the Shared Services. Fibre optics, patch panels, and patch cables to be provided as shown in ROGE-T-SA-000005.

14.2 Fibre optical network installation

The contractor shall deliver the single mode cables, patch panels and patch cables for the onshore and offshore part of the fibre optical network installation. The subsea fibre optical cables, splice boxes and patch panels for interfacings shall be supplied by the subsea cable supplier and installed by the contractor. Splicing and testing shall be performed by subsea cable supplier.

For reference see ROGE-T-SA-000005.

Cables for telephones, cameras, WI-FI and outlets shall be at least CAT 6 cabling.

IV

BIJLAGE: CERTIFICERING

DNV·GL

CONFORMITY STATEMENT

Statement No.: Issued:

07843HHO **2016-01-26**

Issued for:

BASIC DESIGN
as part of the Invitation to Tender for the EPC-contracts of the Wind Op Zee Standard AC Transformer Platform

Comprising:

2 x 350 MVA Transformer Power Trains and Auxiliaries
Specified in Annex 1

Issued to:

TenneT TSO B.V.
Utrechtseweg 310
6812 AR Arnhem
The Netherlands

According to Service Specification:

DNVGL-SE-0073:2014-12
Project certification of wind farms according to IEC 61400-22

Based on:

Documentation listed in Annex 2, including open comments

Conclusion:

There remain no concerns that the current Basic Design can be developed into a Detailed Design which is compliant with our code DNV-OS-J201 – Offshore Substations for Wind Farms

Hamburg, 2016-01-26 **Hamburg, 2016-01-26**

Head of Department, Offshore Installations Principal Consultant and Project Manager

CONFORMITY STATEMENT - ANNEX 1

07843HHO

Substation

▪ Type	Transformer Platform, Unmanned
▪ Designer	Ramboell Oil and Gas, Esbjerg, Denmark
▪ Rated voltage in/out	66/220 kV
▪ Rated capacity	2 x 350 MVA
▪ Main components - Main Transformers - Switchgear - Utilities and Auxiliaries - Type of Substructure - Type of foundation	 Oil Filled Gas Insulated Jacket Piled Jacket
▪ Places of Design Review	Hamburg, Arnhem, Esbjerg
▪ Period of Design Review	2015-04-01 - 2016-01-26

CONFORMITY STATEMENT - ANNEX 2

List of Documents, Reviewed and Commented

Contents Database: TenneT_AC_OSS_Design Verification
DNV·GL Project: 4762-15-12713-408

IV.00 General

Doc_No	Revision	Title	Status
GTR		GEOTECHNICAL REPORT: WIND FARM SITE I&II, BORSSELE WIND FARM ZONE	I
MDR		MASTER DOCUMENT LIST FOR CONCEPT & BASIC DESIGN PHASE	I
ONL-TTB-00003-MA-EN	00	3D MODEL	I
ONL-TTB-00044-MA-EN	01	BASIC DESIGN REPORT	A/C
ONL-TTB-00150-MA-EN	00	GEOTECHNICAL DESIGN REPORT	N
ONL-TTB-00166-MA-EN	00	LIST OF MECHANICAL PLOT PLANS	I
ONL-TTB-00173-MA-EN	00	PLOTPLAN ELEVATION, LOOKING EAST	N
ONL-TTB-00174-MA-EN	00	PLOTPLAN ELEVATION, LOOKING NORTH	N
ONL-TTB-00175-MA-EN	00	PLOTPLAN ELEVATION, LOOKING EASTPLOTPLAN ELEVATION, LOOKING EAST (WITH JACKET)	N
ONL-TTB-00176-MA-EN	00	PLOTPLAN ELEVATION, LOOKING NORTH (WITH JACKET)	N
ONL-TTB-00178-MA-EN	00	PLOTPLAN ELEVATION, LOOKING SOUTH	N
ONL-TTB-00179-MA-EN	00	PLOTPLAN ELEVATION, LOOKING EAST	N
ONL-TTB-00180-MA-EN	00	PLOTPLAN ISOMETRIC VIEW LOOKING NORTH-EAST (WITH JACKET)	N
ONL-TTB-00181-MA-EN	00	PLOTPLAN ISOMETRIC VIEW LOOKING SOUTH-WEST (WITH JACKET)	N
ONL-TTB-00182-MA-EN	00	PLOTPLAN ISOMETRIC VIEW LOOKING NORTH-WEST (BACKWARDS)	N
ONL-TTB-00183-MA-EN	00	PLOTPLAN ISOMETRIC VIEW LOOKING SOUTH-WEST	N
ONL-TTB-00184-MA-EN	00	PLOTPLAN ISOMETRIC VIEW LOOKING NORTH - WEST	N
ONL-TTB-00185-MA-EN	00	PLOTPLAN ISOMETRIC VIEW LOOKING SOUTH-EAST	N

IV.01 Structure

Doc_No	Revision	Title	Status
		BASIC DESIGN – JACKET ON-BOTTOM STABILITY ANALYSIS REPORT	N/C
ONL-TTB-00004-MA-EN	00	DESIGN BRIEF TOPSIDES	N/C
ONL-TTB-00005-MA-EN	00	DESIGN BRIEF INPLACE ANALYSIS	N/C
ONL-TTB-00006-MA-EN	00	DESIGN BRIEF – NATURAL FREQUENCY ANALYSIS	N
ONL-TTB-00007-MA-EN	00	DESIGN BRIEF - DETERMINISTIC FATIGUE ANALYSIS	N
ONL-TTB-00008-MA-EN	00	DESIGN BRIEF - INSTALLATION ANALYSIS	N
ONL-TTB-00053-MA-EN	00	LIST FOR TOPSIDE PRIMARY STEEL DRAWINGS	I
ONL-TTB-00054-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR LADDERS 1	A
ONL-TTB-00055-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR LADDERS 2	A
ONL-TTB-00056-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR STAIRS	A
ONL-TTB-00057-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR WALKWY GRATING AND STAIR TREADS	A
ONL-TTB-00058-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR REMOVABLE HANDRAILS	A
ONL-TTB-00059-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR FIXED HANDRAILS	A
ONL-TTB-00060-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR SELF CLOSING GATE	A
ONL-TTB-00061-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR REMOVABLE HEAVY DUTY HANDRAILS	A
ONL-TTB-00062-MA-EN	00	TOPSIDES STRUCTURES TYPICAL DETAILS FOR FIXED HEAVY DUTY HANDRAILS	A
ONL-TTB-00063-MA-EN	00	TOPSIDES STRUCTURES ISOMETRIC VIEW LOOKING NORTH WEST	A
ONL-TTB-00064-MA-EN	00	TOPSIDES STRUCTURES CABLE DECK EL 20.000 T.O.S. FRAMING PLAN	A
ONL-TTB-00065-MA-EN	00	TOPSIDES STRUCTURES MAIN DECK EL. 26.500 T.O.S. FRAMING PLAN	A
ONL-TTB-00066-MA-EN	00	TOPSIDES STRUCTURES UTILITY DECK EL 34.000 T.O.S. FRAMING PLAN	A
ONL-TTB-00067-MA-EN	00	TOPSIDES STRUCTURES CONTROL DECK EL 38.000 T.O.S. FRAMING PLAN	A

IV.01 Structure

Doc_No	Revision	Title	Status
ONL-TTB-00068-MA-EN	00	TOPSIDES STRUCTURES ROOF DECK EL 42.000 T.O.S. FRAMING PLAN	A
ONL-TTB-00069-MA-EN	00	TOPSIDES STRUCTURES UPPER ROOF DECK EL 44.000 T.O.S. FRAMING PLAN	A
ONL-TTB-00070-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW 1 LOOKING NORTH	A
ONL-TTB-00071-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW 2 LOOKING NORTH	A
ONL-TTB-00072-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW 3 LOOKING NORTH	A
ONL-TTB-00073-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW 4 LOOKING NORTH	A
ONL-TTB-00074-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW A LOOKING NORTH	A
ONL-TTB-00075-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW B LOOKING WEST	A
ONL-TTB-00076-MA-EN	00	TOPSIDES STRUCTURES TRUSS ELEVATION COLUMN ROW C LOOKING WEST	A
ONL-TTB-00077-MA-EN	00	TOPSIDES STRUCTURES ELEVATION AT 6000MM SOUTH OF GRIDLINE 1 LOOKING NORTH	A
ONL-TTB-00078-MA-EN	00	TOPSIDES STRUCTURES ELEVATION 7000MM SOUTH AND NORTH OF GRIDLINE LOOKING NORTH	A
ONL-TTB-00082-MA-EN	00	TOPSIDES STRUCTURES CABLE DECK EL 20.000 T.O.S. DECK TYPES	A
ONL-TTB-00083-MA-EN	00	TOPSIDES STRUCTURES MAIN DECK EL 26.500 T.O.S. DECK TYPES	A
ONL-TTB-00084-MA-EN	00	TOPSIDES STRUCTURES UTILITY DECK EL 34.000 T.O.S. DECK TYPES	A
ONL-TTB-00085-MA-EN	00	TOPSIDES STRUCTURES CONTROL DECK EL 38.000 T.O.S. DECK TYPES	A
ONL-TTB-00086-MA-EN	00	TOPSIDES STRUCTURES ROOF DECK EL 42.000 T.O.S. DECK TYPES	A
ONL-TTB-00109-MA-EN	01	DRAWING LIST FOR JACKET STRUCTURE	I
ONL-TTB-00110-MA-EN	00	JACKET STRUCTURE GENERAL NOTES I	A/C
ONL-TTB-00111-MA-EN	00	JACKET STRUCTURE GENERAL NOTES II	A
ONL-TTB-00112-MA-EN	00	JACKET STRUCTURE GENERAL NOTES III	A

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IV.01 Structure

Doc_No	Revision	Title	Status
ONL-TTB-00113-MA-EN	00	JACKET STRUCTURE GENERAL ARRANGEMENT ROW A	A
ONL-TTB-00114-MA-EN	00	JACKET STRUCTURE ISOMETRIC VIEW	A
ONL-TTB-00115-MA-EN	00	JACKET STRUCTURE MAIN FRAME BRACING ROW A	A
ONL-TTB-00116-MA-EN	00	JACKET STRUCTURE MAIN FRAME BRACING ROW C	A
ONL-TTB-00117-MA-EN	00	JACKET STRUCTURE MAIN FRAME BRACING ROW 1	A
ONL-TTB-00118-MA-EN	00	JACKET STRUCTURE MAIN FRAME BRACING ROW 3	A
ONL-TTB-00119-MA-EN	00	JACKET STRUCTURE PLANS ELEV. (+) 17.300 AND ELEV. (+) 10.200	A
ONL-TTB-00120-MA-EN	00	JACKET STRUCTURE PLAN ELEV. (-)6.000	A
ONL-TTB-00121-MA-EN	00	JACKET STRUCTURE PLAN ELEV. (-)28.000	A
ONL-TTB-00122-MA-EN	00	JACKET STRUCTURE LEG MAKE-UP	A
ONL-TTB-00123-MA-EN	00	JACKET STRUCTURE SKIRT PILE SLEEVES	A
ONL-TTB-00124-MA-EN	00	JACKET STRUCTURE MUDMATS	A
ONL-TTB-00125-MA-EN	00	JACKET STRUCTURE BOAT LANDING AND STAIRS PLAN AND ELEVATION	I
ONL-TTB-00126-MA-EN	00	JACKET STRUCTURE BOAT LANDING SECTIONS AND DETAILS	I
ONL-TTB-00127-MA-EN	00	JACKET STRUCTURE J-TUBES PLANS AND NUMBERING	A
ONL-TTB-00128-MA-EN	00	JACKET STRUCTURE J-TUBES TYPICAL MAKE-UP AND SECTIONS	A
ONL-TTB-00129-MA-EN	00	JACKET STRUCTURE LIFTING ARRANGEMENT, LIFT POINTS	A
ONL-TTB-00130-MA-EN	00	JACKET STRUCTURE BELLMOUTH FOR 66KW J-TUBE AND 220 KW J-TUBE	I
ONL-TTB-00131-MA-EN	00	JACKET STRUCTURE CABLE DECK - PLAN AND SECTIONS	A
ONL-TTB-00132-MA-EN	00	JACKET STRUCTURE PILE MAKE-UP	A
ONL-TTB-00133-MA-EN	00	JACKET STRUCTURE ANODES	A
ONL-TTB-00148-MA-EN	00	SPECIFICATION FOR JACKET AND PILES	A/C
ONL-TTB-00187-MA-EN	00	WEIGHT REPORT FOR TOPSIDES	N/C
ONL-TTB-00188-MA-EN	00	CABLE PULLING REPORT	I
ONL-TTB-00192-MA-EN	00	STRUCTURAL ANALYSES FOR TOPSIDES	N/C

IV.01 Structure

Doc_No	Revision	Title	Status
ONL-TTB-00193-MA-EN	00	BASIC DESIGN FOR JACKET NATURAL FREQUENCY ANALYSIS REPORT	N/C
ONL-TTB-00197-MA-EN	00	JACKET INPLACE ANALYSIS REPORT	A/C
ONL-TTB-00198-MA-EN	00	JACKET STRUCTURE J-TUBES, HANG OFF SUPPORTS	I

IV.02 Safety

Doc_No	Revision	Title	Status
ONL-TTB-00021-MA-EN	01	HAZID REPORT - CHANGED LAYOUT	N
ONL-TTB-00022-MA-EN	00	UTILITY HAZOP REPORT	I
ONL-TTB-00023-MA-EN	00	ELECTRICAL HAZOP REPORT	I
ONL-TTB-00026-MA-EN	00	STANDARD OFFSHORE SUBSTATION QUANTITATIVE RISK ASSESSMENT	A
ONL-TTB-00027-MA-EN	00	STANDARD OFFSHORE SUBSTATION ESCAPE, EVACUATION AND RESCUE ANALYSIS (EERA)	A
ONL-TTB-00028-MA-EN	00	STANDARD OFFSHORE SUBSTATION SPECIFICATION FOR LIFE SAVING EQUIPMENT	A
ONL-TTB-00029-MA-EN	00	STANDARD OFFSHORE SUBSTATION SPECIFICATION FOR PIPING SYSTEM	A
ONL-TTB-00030-MA-EN	00	STANDARD OFFSHORE SUBSTATION DRAWING LIST FOR FIRE AND SAFETY PLANS	I
ONL-TTB-00031-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL CABLE DECK FIRE AND SAFETY	A/C
ONL-TTB-00032-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL MAIN DECK FIRE AND SAFETY	A
ONL-TTB-00033-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL UTILITY DECK FIRE AND SAFETY	A/C
ONL-TTB-00034-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL CONTROL DECK FIRE AND SAFETY	A/C
ONL-TTB-00035-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL ROOF DECK FIRE AND SAFETY	A/C
ONL-TTB-00189-MA-EN	00	SAFETY STRATEGY	N/C
ONL-TTB-00194-MA-EN	00	CAUSE AND EFFECT DIAGRAM FAS (01 TO 32)	N/C

IV.03 Fire Fighting

Doc_No	Revision	Title	Status
ONL-TTB-00042-MA-EN	00	SPECIFICATION FOR FIRE FIGHTING SYSTEMS	A
ONL-TTB-00108-MA-EN	00	SPECIFICATION FOR FIRE ALARM SYSTEM	A
ONL-TTB-00190-MA-EN	00	RISK ASSESSMENT OF ACTIVE FIREFIGHTING EQUIPMENT	N

IV.04 Mechanical

Doc_No	Revision	Title	Status
HVA/C		HVA/C DESIGN BRIEF	N
ONL-TTB-00002-MA-EN	00	ROOM MATRIX, STANDARD OFFSHORE SUBSTATION	N
ONL-TTB-00009-MA-EN	01	DESIGN BRIEF FOR UTILITY SYSTEMS	N
ONL-TTB-00039-MA-EN	00	SPECIFICATION FOR CRANE	A
ONL-TTB-00040-MA-EN	00	HOISTS, LIFTING GEAR AND WINCH	A
ONL-TTB-00041-MA-EN	00	SPECIFICATION FOR HVAC SYSTEM.	A
ONL-TTB-00142-MA-EN	00	UFD - UTILITY FLOW DIAGRAM DRAIN SYSTEM	A
ONL-TTB-00143-MA-EN	00	UFD - UTILITY FLOW DIAGRAM FRESH WATER SYSTEM	A
ONL-TTB-00144-MA-EN	00	UFD - UTILITY FLOW DIAGRAM AHU - HVAC SYSTEM	A
ONL-TTB-00145-MA-EN	00	UFD - UTILITY FLOW DIAGRAM AHU - HVAC SYSTEM	A
ONL-TTB-00146-MA-EN	00	UFD - UTILITY FLOW DIAGRAM DIESEL STORAGE SYSTEM	A
ONL-TTB-00147-MA-EN	00	UFD - UTILITY FLOW DIAGRAM SINGLE LINE HVAC SYSTEM	A
ONL-TTB-00151-MA-EN	00	LIST OF HVA/C SYSTEMS FUNCTIONAL P AND IDS	I
ONL-TTB-00152-MA-EN	00	LEGEND FUNCTIONAL PIDS	I
ONL-TTB-00153-MA-EN	00	HVAC SYSTEM FUNCTIONAL P AND ID - AHU 1	A
ONL-TTB-00154-MA-EN	00	HVAC SYSTEM FUNCTIONAL P AND ID - AHU 2	A
ONL-TTB-00155-MA-EN	00	HVAC SYSTEM FUNCTIONAL P AND ID - TYPICAL HOOK UP	A
ONL-TTB-00156-MA-EN	00	CLOSED COOLING SYSTEM FUNCTIONAL P AND ID - CONDENSATOR COOLING CIRCUIT	A
ONL-TTB-00157-MA-EN	00	CLOSED COOLING SYSTEM P AND ID - EXPANSION VESSELS	A
ONL-TTB-00158-MA-EN	00	CLOSED COOLING SYSTEM P AND ID - RFU UNITS (TYP)	A
ONL-TTB-00159-MA-EN	00	CLOSED COOLING SYSTEM FUNCTIONAL P AND ID - BUFFER VESSEL AND CIRCULATION PUMPS	A
ONL-TTB-00161-MA-EN	00	LEGEND FUNCTIONAL P ANS IDS 2	I
ONL-TTB-00162-MA-EN	00	HAZARDOUS DRAIN SYSTEMS FUNCTIONAL P AND ID	A
ONL-TTB-00163-MA-EN	00	OIL SEPARATOR FUNCTIONAL P AND ID	A
ONL-TTB-00164-MA-EN	00	FRESH WATER SYSTEM FUNCTIONAL P AND ID	A

IV.04 Mechanical

Doc_No	Revision	Title	Status
ONL-TTB-00165-MA-EN	00	DIESEL FUEL STORAGE SYSTEM FUNCTIONAL P AND ID	A
UT		UTILITY FLOW DIAGRAMS	I

IV.05 Piping

Doc_No	Revision	Title	Status
ONL-TTB-00036-MA-EN	00	SPECIFICATION FOR FRESH WATER SYSTEM	A
ONL-TTB-00037-MA-EN	00	SPECIFICATION FOR DRAIN SYSTEM	A

IV.07 Electrical

Doc_No	Revision	Title	Status
ONL-TTB-00038-MA-EN	00	SPECIFICATION FOR DIESEL GENERATOR SYSTEM	A
ONL-TTB-00043-MA-EN	00	SPECIFICATION FOR AUXILIARY SCADA SYSTEM	N
ONL-TTB-00045-MA-EN	00	SPECIFICATION FOR IP SERVICES	I
ONL-TTB-00046-MA-EN	00	SPECIFICATION FOR FIBRE OPTICAL NETWORK	I
ONL-TTB-00047-MA-EN	00	SPECIFICATION FOR CCTV SYSTEM	I
ONL-TTB-00048-MA-EN	00	SPECIFICATION FOR PA/GA SYSTEM	A
ONL-TTB-00049-MA-EN	00	SPECIFICATION FOR NAVIGATION AID	A
ONL-TTB-00096-MA-EN	00	NAVAID EQ LAYOUT CABLE DECK	N
ONL-TTB-00097-MA-EN	00	BLOCK SCHEMATIC IT SYSTEMS	I
ONL-TTB-00098-MA-EN	00	BLOCK DIAGRAM FIBRE OPTICAL	I
ONL-TTB-00099-MA-EN	00	BLOCK SCHEMATIC PA/GA SYSTEM	A
ONL-TTB-00100-MA-EN	00	BLOCK DIAGRAM CCTV SYSTEM	I
ONL-TTB-00101-MA-EN	00	BLOCK DIAGRAM NAVIGATION AID SYSTEM	N
ONL-TTB-00103-MA-EN	00	STANDARD OFFSHORE SUBSTATION SPECIFICATION FOR 110 VDC - 400-230 VAC UPS	A
ONL-TTB-00104-MA-EN	00	STANDARD OFFSHORE SUBSTATION SPECIFICATION FOR LOW VOLTAGE EQUIPMENT	A
ONL-TTB-00107-MA-EN	00	AUXILIARY SCADA INTERFACE BLOCK DIAGRAM TAG NO. AAF20	N
ONL-TTB-00134-MA-EN	00	ELECTRICAL LOAD LIST	A
ONL-TTB-00135-MA-EN	00	OVERALL 220 66KV CABLEWAY LAYOUT CABLE DECK	N
ONL-TTB-00136-MA-EN	00	STANDARD 700 MW HVAC OFFSHORE SUBSTATION LOW VOLTAGE OVERALL SINGLE LINE DIAGRAM	A
ONL-TTB-00137-MA-EN	00	STANDARD 700 MW HVAC OFFSHORE SUBSTATION ELECTRICAL BLOCK DIAGRAM	N
ONL-TTB-00138-MA-EN	00	STANDARD 700 MW HVAC OFFSHORE SUBSTATION OVERALL EARTHING AND BONDING, PE	A
ONL-TTB-00139-MA-EN	00	STANDARD 700 MW HVAC OFFSHORE SUBSTATION TYPICAL BONDING CONNECTIONS	A
ONL-TTB-00140-MA-EN	00	STANDARD 700 MW HVAC OFFSHORE SUBSTATION TYPICAL EARTH BOSS AND GLAND CONNECTIONS	A
ONL-TTB-00160-MA-EN	00	LIST OF UTILITY SYSTEMS. FUNCTIONAL P AND IDS	I

IV.07 Electrical

Doc_No	Revision	Title	Status
ONL-TTB-00167-MA-EN	00	CABLE DECK EL.20.000 T.O.S.	N
ONL-TTB-00168-MA-EN	00	MAIN DECK EL.26.500 T.O.S.	N
ONL-TTB-00170-MA-EN	00	UTILITY DECK EL.34.000 T.O.S.	N
ONL-TTB-00171-MA-EN	00	CONTROL DECK EL.38.000 T.O.S.	N
ONL-TTB-00172-MA-EN	00	ROOF DECK EL.+42.000 - +44.000 T.O.S.	N
ONL-TTB-00191-MA-EN	00	SPECIFICATION FOR EARTHING, BONDING AND CABLE WAYS	A

IV.08 Material

Doc_No	Revision	Title	Status
ONL-TTB-00149-MA-EN	00	SPECIFICATION FOR CORROSION PROTECTION	H

IV.09 Fabrication

Doc_No	Revision	Title	Status
ONL-TTB-00050-MA-EN	00	TOPSIDES STRUCTURES GENERAL NOTES WELDING AND FABRICATION	H
ONL-TTB-00051-MA-EN	00	TOPSIDES STRUCTURES GENERAL NOTES WELDING AND FABRICATION	A
ONL-TTB-00052-MA-EN	00	TOPSIDES STRUCTURES GENERAL NOTES WELDING AND FABRICATION	A

DNV·GL Project: 4762-15-12713-408

TenneT_AC_OSS_Design Verification

Consolidated Comment List

Opinion about Certification (open comments)

Document No.	Revision	Title
		BASIC DESIGN – JACKET ON-BOTTOM STABILITY ANALYSIS REPORT

Reference	DNV·GL-Comment
1 §1.1	The on-bottom stability has been shown for a jacket without any stabbed piles. As this is sufficient for the basic design in the detail design all installation stages shall be shown by the designer. (e.g. 1 pile stabbed to 4 piles stabbed).

Document No.	Revision	Title
ONL-TTB-00004-MA-EN	**00**	**DESIGN BRIEF TOPSIDES**

Reference	DNV·GL-Comment
1 §3.3.2	Ice loads shall not be considered in the global Topsides design. If no ice loads shall be considered then a procedure about the removal of ice should be included or a meteological expertise report should be provided which states that never ice loads are expected on the locations.

Document No.	Revision	Title
ONL-TTB-00005-MA-EN	**00**	**DESIGN BRIEF INPLACE ANALYSIS**

Reference	DNV·GL-Comment
1 §4.9.3	Please add global allowable misalignments for the installed jacket.
2 §5.2.4	Please include that also for the 2nd global sway mode the DAF shall be calculated and that for each wave direction the DAF will be calculated with respect to the 1st and 2nd global sway mode.

Document No.	Revision	Title
ONL-TTB-00031-MA-EN	**00**	**STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL CABLE DECK FIRE AND SAFETY**

Reference	DNV·GL-Comment
1	This Plan shall be more in detail with all relevant informations during the detail design.

Document No.	Revision	Title
ONL-TTB-00033-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL UTILITY DECK FIRE AND SAFETY

Reference	DNV·GL-Comment
1	This Plan shall be more in detail with all relevant informations during the detail design.

Document No.	Revision	Title
ONL-TTB-00034-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL CONTROL DECK FIRE AND SAFETY

Reference	DNV·GL-Comment
1	This Plan shall be more in detail with all relevant informations during the detail design.

Document No.	Revision	Title
ONL-TTB-00035-MA-EN	00	STANDARD OFFSHORE SUBSTATION OFFSHORE GRID NL ROOF DECK FIRE AND SAFETY

Reference	DNV·GL-Comment
1	This Plan shall be more in detail with all relevant informations during the detail design.

Document No.	Revision	Title
ONL-TTB-00044-MA-EN	01	BASIC DESIGN REPORT

Reference	DNV·GL-Comment
2	Page 21 ch. 7.2.9 penetrations in light fire panels shall have an approval by a notified body.

Document No.	Revision	Title
ONL-TTB-00050-MA-EN	00	TOPSIDES STRUCTURES GENERAL NOTES WELDING AND FABRICATION

Reference	DNV·GL-Comment
1	**§4.1 Materials:** In order to do a complete review of provided Table, please provide the minimum design temperature. In addition, selection of steel materials shall be based on DNV-OS-C101, rev.2014, Ch. 2, Sec.3, Table 3.5 and DNV-OS-B101, rev.2012, Ch.2, Sec. 1, therefore this Table needs to be updated accordingly. Please also specify for each steel material a specific DNV grade. **Addition, 25.01.2016** Comment is partly closed as comparison is given in DNV-OS-J101. But the minimum design temperature is not given as required. **Addition, 28.01.2016** Minimum design temperature has been now provided with but is not stated in the basic design documentation. The met-ocean report was not basis of review.

Document No.	Revision	Title
ONL-TTB-00110-MA-EN	00	JACKET STRUCTURE GENERAL NOTES I

Reference	DNV·GL-Comment
1	**§ 3. Materials:** **a) § 3.2:** By referring to DNV-OS-C101, rev.2014, Ch. 2, Sec.3, Table 3.5 and DNV-OS-B101, rev.2012, Ch.2, Sec. 1, please specify for each steel material thickness limit and a specific DNV grade. **b) § 3.3:** If all steel materials to be steel type 1 (ST1) why in **§ 3.2** other steel types are provided. Please amend in next revision. **c) § 3.5:** EN 20898-1 and EN 20898-2 are superseed by ISO 898-1 and ISO 898-2 accordingly. Please amend in next revision.

Document No.	Revision	Title
ONL-TTB-00148-MA-EN	00	SPECIFICATION FOR JACKET AND PILES

Reference	DNV·GL-Comment
2	**§ 2.2 'Structural Steel':** a) By referring to doc no ROGE-N-GN-000112-01 'Jacket Structure General Notes I', steel grades of EN 10225 have been selected for Special and Primary members. Therefore, this note 'only EN 10025 materials are selected' should be added only for Secondary members. Please amend in next revision.
3	**§ 2.4 'Standard Sections':** Written sentence '…type S1 steel for secondary steel type.' is found to be not in line with part 3.2 of doc no ROGE-N-GN-000112-01 'Jacket Structure General Notes I'. Where, steel type ST1 is related to special members. Please amend in next revision.
4	**§ 4.4 'Fabrication assembly tolerances':** This section is found to be incomplete. Therefore, please in next revision make a reference to DNV-OS-C401 (2014), Ch.2, Sec.2.

Document No.	Revision	Title
ONL-TTB-00149-MA-EN	00	SPECIFICATION FOR CORROSION PROTECTION

Reference	DNV·GL-Comment
1 2.1	3. Para: Please remove Magnesium, because Magnesium anodes will lead to over-protection, i.e. polarisation more negativ than the acceptable value of -1,15 V (Magnesium anodes will lead to -1,6 V). See DNV-RP-B401 [13], Chapter 5.4.2 and 5.6.
2 2.1	4. Para/last Point: Please correct "Cathodic protection with aluminium-based anodes"
3 2.1	Table: Method duplex system Please correct the "Specification" according to EN ISO 12944-5, Table A.7 for corrosion category C5-M and high expected durability H (see System No. A7.13).
4 2.1	Table: Submerged zone Please correct nominal dry film thickness: min. 450 mm in case of System A6.07.
5 2.2	Please start this chapter with "surface preparation shall be in accordance to Norsok M-501 [12]". Please correct this reference in Chapter 1.4. "Rev.No.6" not Rev. No.5 (2004).

Document No.	Revision	Title
ONL-TTB-00187-MA-EN	00	WEIGHT REPORT FOR TOPSIDES

Reference	DNV·GL-Comment
1	Figure 3-2 - Topside Views Please add all remaining views (looking North, South and East) in the weight report. Please add below the figures also for the view directions North&South and East&West the respective wind areas for the topsides. **Addition, 28.01.2016, MHIET** The remaining views together with respective wind areas shall be included in the respective design documentation. A load management strategy should be included in a report "Load management and weight report" but could be also included in other documents of the design documentation.
2	Load plans have been included in the weight report. But only for the laydown areas a specified load has been included in the load plan. Please add also for the remaining areas the local and global design loads as they are mentioned in the inplace report. This will help the owner to decide later which loads are possible on each area and to install a load management (e.g. important for treat ment of ice and snow loads as they are not considered currently). Please add for each room/area the respective size in [m²]. The room size together with local&global loads can be also added to the §5 "Section and Area Definition" of the weight report.

Document No.	Revision	Title
ONL-TTB-00189-MA-EN	00	SAFETY STRATEGY

Reference	DNV·GL-Comment
1	7.4.1 The paint or spray shall shall be in line with the FTP Code and have a type approval for such application
2	7.4.3 Outer weak walls shall not impaire escape routes

Document No.	Revision	Title
ONL-TTB-00192-MA-EN	00	STRUCTURAL ANALYSES FOR TOPSIDES

Reference	DNV·GL-Comment
1	Treatment of Ice and Snow loads "Ice and snow loads are not considered in the present analysis." As requested by DNV GL ice and snow loads shall be considered for the design in any case. But the handling of ice and snow loads can be treated as stated hereafter: 1) If from a met-ocean assessor a statement shows, that no ice or snow loads can occurs, then no ice and snow loads can be considered. But until now we have no statement. 2) For the global load transfer to the jacket the ice and snow can be compared with the live loads and this shall be included in a load management strategy. This strategy should consider the live loads which are possible during maintenance and it should be decided, if they can occur during ice and snow loads. In any case it shall be assessed, that no overutilizations exist.
4	Color Coded 3D-Model Please add to Figure 5-1 the sections of the members to the different colores or add a separete 3D-model.
5	Information regarding the min/max ambient air temperature shall be included.

Document No.	Revision	Title
ONL-TTB-00193-MA-EN	00	BASIC DESIGN FOR JACKET NATURAL FREQUENCY ANALYSIS REPORT

Reference	DNV·GL-Comment
1	Topsides Weight Please include explicit the topsides weight in the report and not only a reference.

Document No.	Revision	Title
ONL-TTB-00194-MA-EN	00	CAUSE AND EFFECT DIAGRAM FAS (01 TO 32)

Reference	DNV·GL-Comment
2	Each room with inert gas release should have an additional alarm at each entrance to the room.

Document No.	Revision	Title
ONL-TTB-00196-MA-EN	00	SCOUR ASSESSMENT AROUND JACKET FOUNDATIONS

Reference	DNV·GL-Comment
1	Please remove red markers for track changes.

Document No.	Revision	Title
ONL-TTB-00197-MA-EN	00	JACKET INPLACE ANALYSIS REPORT

Reference	DNV·GL-Comment
1	Wind Loads Please include the wind loads from the topside explicit in the report.

Reference	DNV·GL-Comment
2	Design Temperature We are missing a defined ambient design temperature as required with the design basis. Please include this temperature.
3	Design Utilizations The design utilizations in figure 8-1 showing overutilizations with 6%. For the basic design stage a utilization of 80-90 % is good engineering praxis. The overutilization shall be in accordance with agreed codes and standards and shall not exceed 100% unless not otherwise noted.
3	Marine Growth The marine growth thickness ranges from 150mm (-1(?)m to -6m) to 50mm (-6m to -30m). Please check table 4-11 against the DNV-RP-C205 April 2014. The marine growth thickness ranges from 100mm (+2m to -40m) to 50mm (below -40m). Please be aware that these values are given for a location between 56 to 59 °N. this project is proposed to be installed at 51.5 °N. It is advisable to obtain site specific information. As no site specific value has been provided this should be confirmed during the detail design. Addition, 28.01.2016, MHIET As the met-ocean report was not available during the review of the design documentation the comment remain open and shall be followed up during the detail design phase.

Documents in this report: 32

V

BIJLAGE: PLATTEGROND BRANDBEVEILIGING PLATFORM BETA

OFFSHORE GRID NL

E3.3.5

Document Title:

Standard Offshore Substation
Fire and Safety Plans
(1 list & 5 drawings)

02	05-09-2016	Issued for ITT, Information Notice 9	TenneT	TenneT	TenneT
01	15-01-2016	Issued for ITT			
Rev.	Revision date (DD-MM-YYYY)	Reason for issue	Prepared by	Verified by	MVJ by

Project no.: 1100015665	
Site code:	Page: 1 of 7

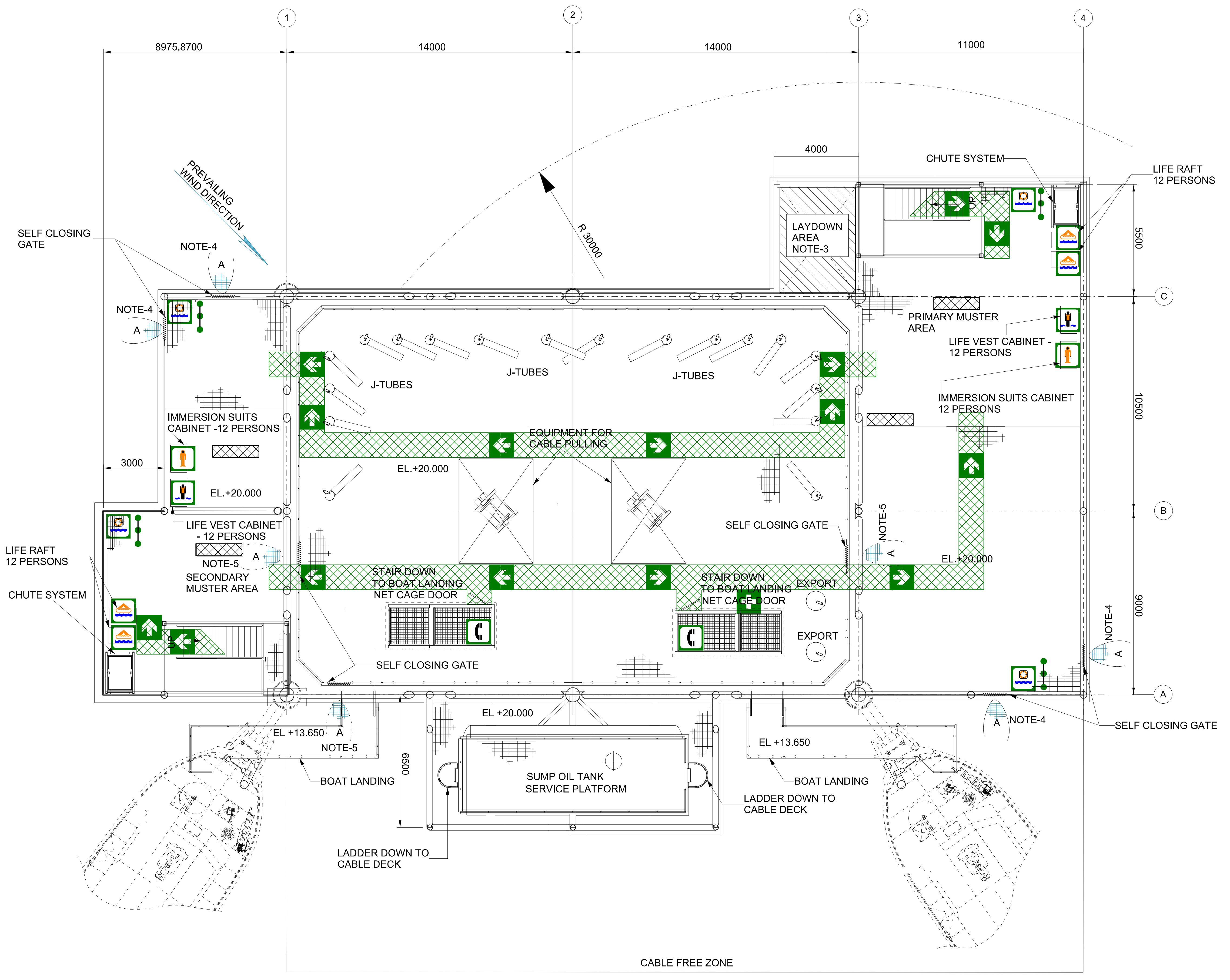
TenneT Document No.:

ONL-TTB-00212

	RAMBØLL Job no. 1100015665	PROJECT TENNET				
			1	31-AUG-2016		
			0	22-JAN-2016		
DRAWING LIST		Standard AC Platform - TENNET_STD700MW	B	27-NOV-2015		
			A	30-JUN-2015		
			REV.	DATE	MADE BY	CHECKED	APPROVED

PLATFORM TENNET_STD700MW — **DISCIPLINE 09 - FIRE AND SAFETY PLANS**

DENOMINATOR	PLATFORM		MODULE	DISCI-PLINE	SEQ. NO	SHEET NO	DRAWING TITLE:	DRAW. SIZE	DRAWN BY	CAD	MAINT. SYSTEM	REVI-SION	REVISION DATE	REMARKS:
	T	T	B	09	001	01	CABLE DECK	A1	100970	I	-	1	31-aug-2016	
	T	T	C	09	001	01	MAIN DECK	A1	100970	I	-	1	31-aug-2016	
	T	T	D	09	001	01	UTILITY DECK	A1	100970	I	-	1	31-aug-2016	
	T	T	E	09	001	01	CONTROL DECK	A1	100970	I	-	1	31-aug-2016	
	T	T	G	09	001	01	ROOF DECK: EL	A1	100970	I	-	1	31-aug-2016	



CABLE DECK - EL.+20.000 T.O.S

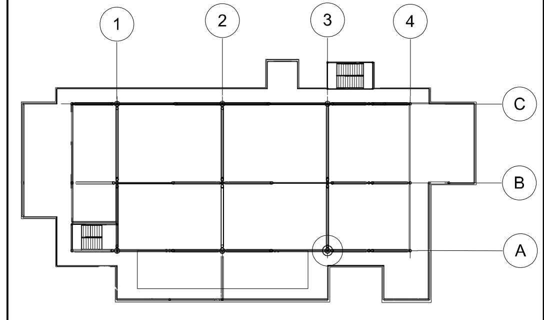
SCALE 1:100

NOTES

LEGENDS

ESCAPE ROUTE	A-0 DECK FIRE RATING
LIFE RAFT	A-15 DECK FIRE RATING
SURVIVAL SUIT	A-60 DECK FIRE RATING
SURVIVAL JACKET	A-0 WALL
LIFE BOUY	A-60 WALL
FB FIRE BLANKET	B-0 WALL
FIRST AID STATION	C WALL
CO2 EXTINGUISHER (IS NOT PERMANENT)	
TELEPHONE	
KNOTTED ROBE	

N



KEY PLAN

Drawing no. | Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
1	31-AUG-2016	LENN/ELO	HSL	MVJ	REISSUED FOR ITT
0	22-JAN-2016	LENN/RDJ	TXR	MVJ	ISSUED FOR ITC
A	27-NOV-2015	LENN/RDJ	HSL	MVJ	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

CABLE DECK
FIRE & SAFETY

Scale	Size	Drawing no.	Rev.
1:100	A1	TT-B-09-001-01	1

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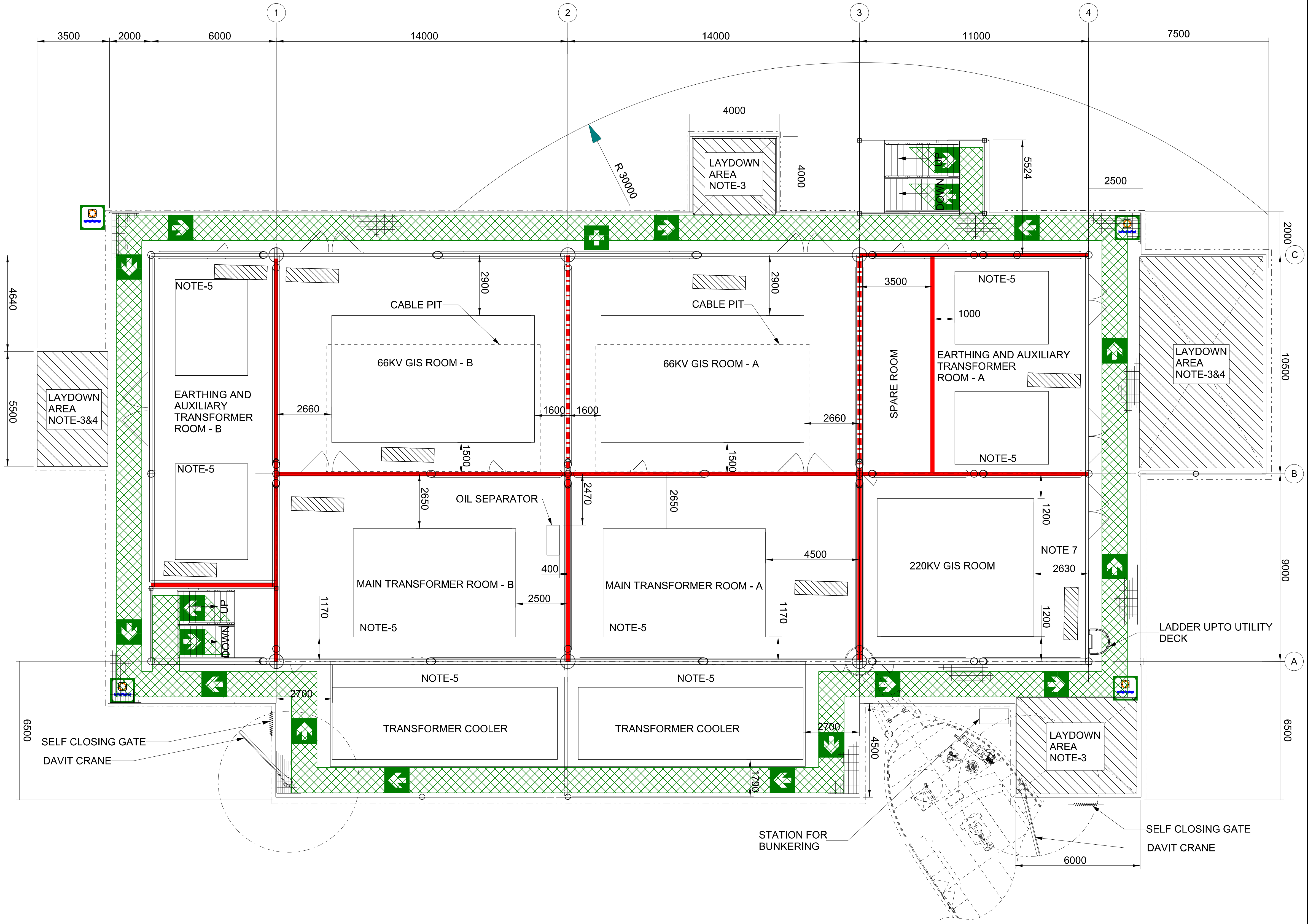


MAIN DECK - EL.+26.500 T.O.S (NOTE-6)

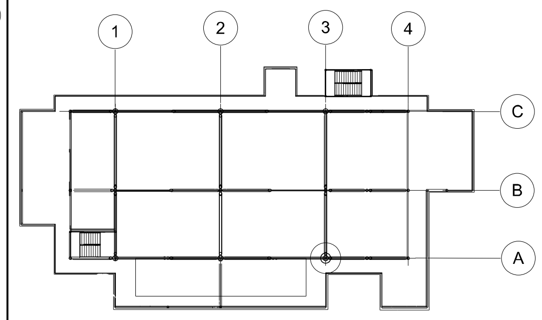
SCALE 1:100

NOTES

LEGENDS

- ESCAPE ROUTE
- LIFE RAFT
- SURVIVAL SUIT
- SURVIVAL JACKET
- LIFE BOUY
- FB FIRE BLANKET
- FIRST AID STATION
- CO_2 EXTINGUISHER (IS NOT PERMANENT)
- A-0 DECK FIRE RATING
- A-15 DECK FIRE RATING
- A-60 DECK FIRE RATING
- A-0 WALL
- A-60 WALL
- B-0 WALL
- C WALL

N



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
1	31-AUG-2016	LENN/ELO	HSL	MVJ	REISSUED FOR ITT
0	22-JAN-2016	LENN/RDJ	TXR	MVJ	ISSUED FOR ITC
A	27-NOV-2015	LENN/RDJ	HSL	MVJ	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

MAIN DECK
FIRE & SAFETY

Scale	Size	Drawing no.	Rev.
1:100	A1	TT-C-09-001-01	1

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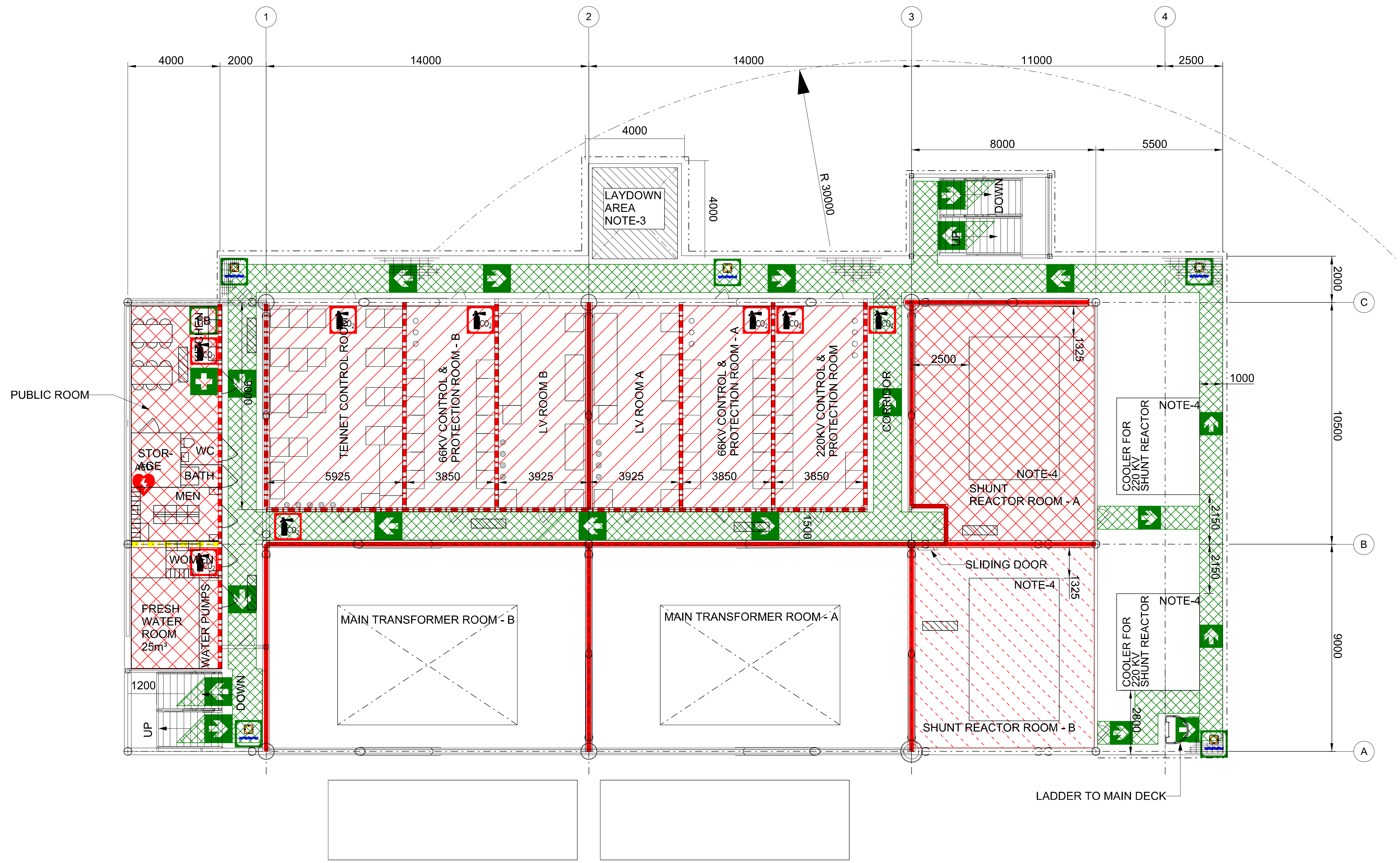
NOTES

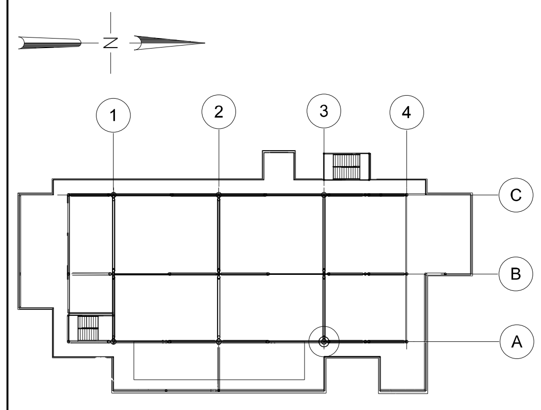
LEGENDS

- ESCAPE ROUTE
- LIFE RAFT
- SURVIVAL SUIT
- SURVIVAL JACKET
- LIFE BOUY
- FB — FIRE BLANKET
- FIRST AID STATION
- CO2 EXTINGUISHER (IS NOT PERMANENT)
- AED — DEFIBRILLATOR
- A-0 DECK FIRE RATING
- A-15 DECK FIRE RATING
- A-60 DECK FIRE RATING
- A-0 WALL
- A-60 WALL
- B-0 WALL
- C WALL



UTILITY DECK - EL. +34.000 T.O.S. (NOTE-5)

SCALE 1:100



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
1	31-AUG-2016	LENN/ELO	HSL	MVJ	REISSUED FOR ITT
0	22-JAN-2016	LENN/RDJ	TXR	MVJ	ISSUED FOR ITC
A	27-NOV-2015	LENN/RDJ	HSL	MVJ	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

UTILITY DECK

FIRE & SAFETY

Scale	Size	Drawing no.	Rev.
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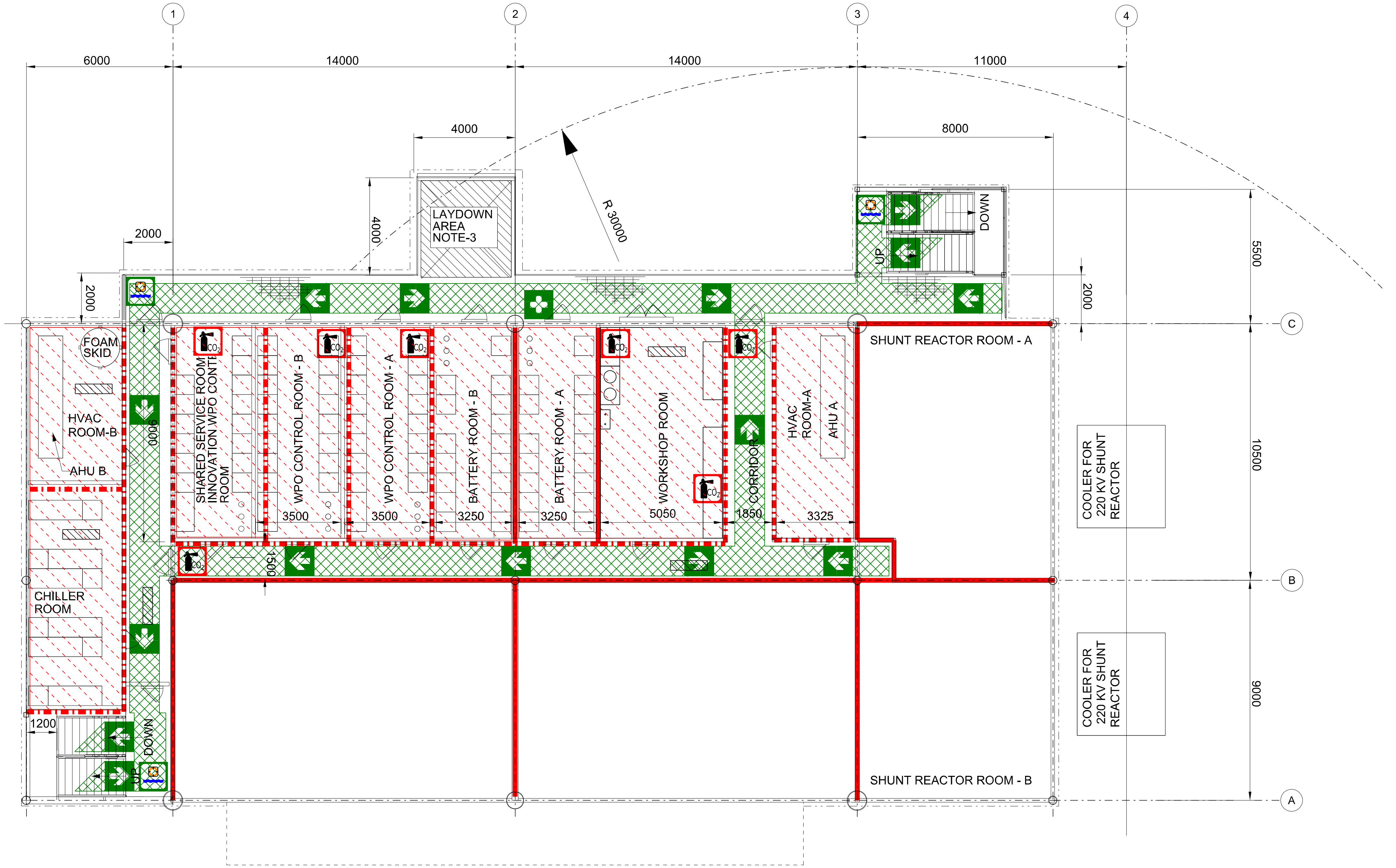

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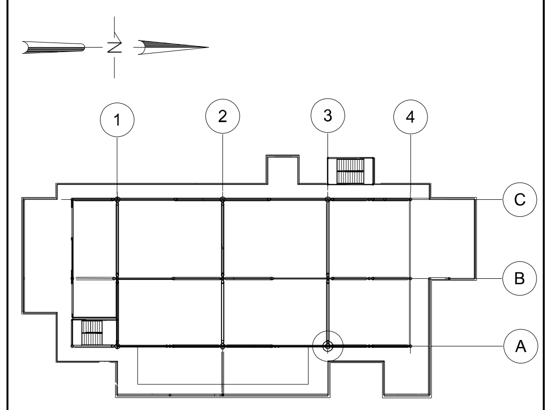
SCALE 1:100

NOTES

LEGENDS

- ESCAPE ROUTE
- LIFE RAFT
- SURVIVAL SUIT
- SURVIVAL JACKET
- LIFE BOUY
- FB FIRE BLANKET
- FIRST AID STATION
- CO2 EXTINGUISHER (IS NOT PERMANENT)
- A-0 DECK FIRE RATING
- A-15 DECK FIRE RATING
- A-60 DECK FIRE RATING
- A-0 WALL
- A-60 WALL
- B-0 WALL
- C WALL



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
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0	22-JAN-2016	LENN/RDJ	TXR	MVJ	ISSUED FOR ITC
A	27-NOV-2015	LENN/RDJ	HSL	MVJ	ISSUED FOR COMMENTS

RAMBOLL — Job no. 1100015665

TenneT — Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

CONTROL DECK
FIRE & SAFETY

Scale	Size	Drawing no.	Rev.
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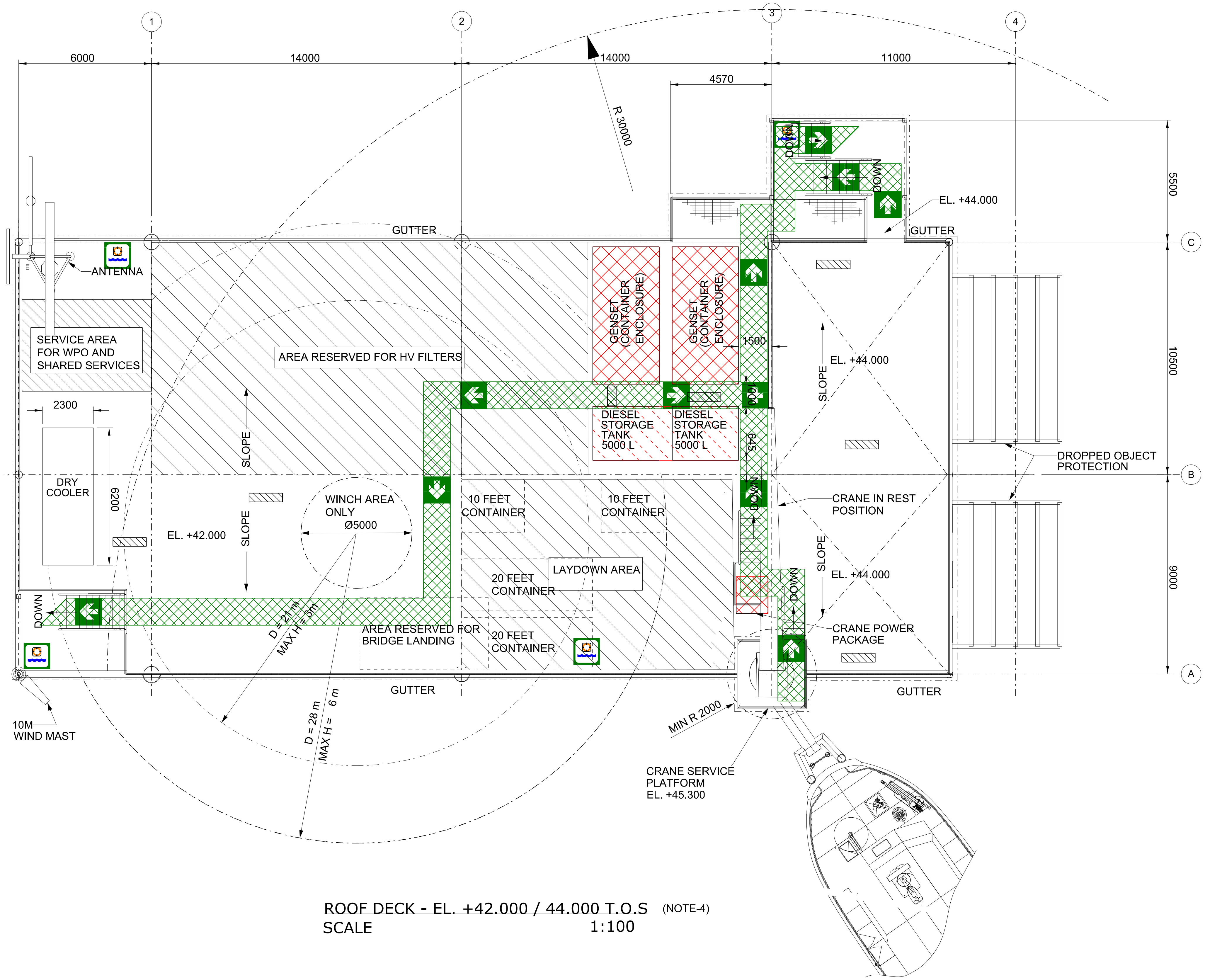


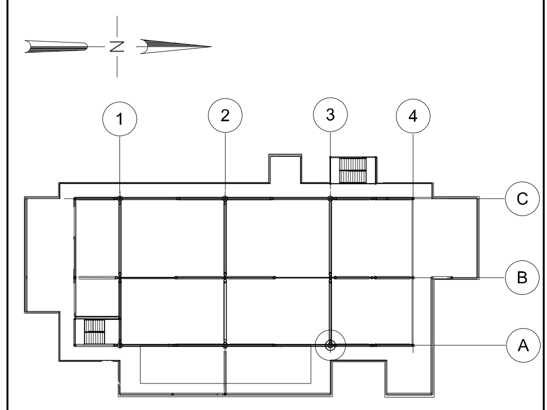
ROOF DECK - EL. +42.000 / 44.000 T.O.S (NOTE-4)

SCALE 1:100

NOTES

LEGENDS

ESCAPE ROUTE	A-0 DECK FIRE RATING
LIFE RAFT	A-15 DECK FIRE RATING
SURVIVAL SUIT	A-60 DECK FIRE RATING
SURVIVAL JACKET	A-0 WALL
LIFE BOUY	A-60 WALL
FB FIRE BLANKET	B-0 WALL
FIRST AID STATION	C WALL
CO2 EXTINGUISHER (IS NOT PERMANENT)	



KEY PLAN

Drawing no.	Reference dwgs.

Rev	Date	Drawn	Chkd	Appr	Description
1	31-AUG-2016	LENN/ELO	HSL	MVJ	REISSUED FOR ITT
0	22-JAN-2016	LENN/RDJ	TXR	MVJ	ISSUED FOR ITC
A	27-NOV-2015	LENN/RDJ	HSL	MVJ	ISSUED FOR COMMENTS

RAMBOLL

Job no. 1100015665

TenneT Taking power further

STANDARD 700MW AC OFFSHORE SUBSTATION

Title

ROOF DECK

FIRE & SAFETY

Scale	Size	Drawing no.	Rev.
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VI

BIJLAGE: MELDING ACTIVITEITENBESLUIT

Melding Activiteitenbesluit

Hierbij doe ik, (namens de heer TenneT TSO B.V.), melding van het starten van het bedrijf **platform Beta, onderdeel van NOZ HKZ**. Het voor de melding gebruikte e-mail adres is

Activiteiten

U heeft geen activiteiten geselecteerd waarvoor specifieke milieuregels uit het Activiteitenbesluit gelden.

Gegevens melder

Naam melder:	.
Adres:	Leeuwenbrug 8 7411TJ DEVENTER
Telefoon:	
Fax:	
E-mail:	

Gegevens drijver

Naam drijver:	de heer TenneT TSO B.V.
Telefoon:	
Fax:	
E-mail:	

Gegevens bedrijf

Naam bedrijf:	platform Beta, onderdeel van NOZ HKZ
Adres bedrijf:	Utrechtseweg 310 6800AS Arnhem
Toelichting locatie:	Melding is voor een platform op zee, onderdeel van het initiatief net op zee Hollandse Kust Zuid van TenneT. Op zee ontbreken adressen en kadastrale gegevens vandaar dat de gegevens van TenneT in Arnhem opgegeven zijn.
KvK nummer:	
Type inrichting:	type A
Reden van melding:	Starten van het bedrijf

Correspondentieadres melding

Correspondentie sturen naar het adres van het bedrijf.

Beschrijving activiteiten

Datum start bedrijf:	01-04-2022
Beschrijving activiteiten:	Platform Beta is een hoofdzakelijk onbemand platform voor verzameling en transport van elektrische energie opgewekt in nabijgelegen windparken.

Bijlage met beschrijving toevoegen:	Nee

Extra informatie bij de melding

Deze melding is onderdeel van een door het rijk gecoördineerde vergunningprocedure. Onderdeel van deze procedure is onder andere een omgevingsvergunning bouwen voor platform Beta. Aangezien bouwen onlosmakelijk verbonden is met milieu is tevens deze melding Activiteitenbesluit gedaan. Bevoegd gezag voor de vergunning en deze melding is Rijkswaterstaat.

Bijlagen op papier

U moet de volgende bijlagen op papier toesturen aan het bevoegd gezag. De waterbeheerder hoeft alleen de bijlagen met een * te ontvangen.

- Indeling bedrijf: *
  - de grenzen van het terrein van uw bedrijf;
  - de ligging en de indeling van de gebouwen;
  - de functie van de te onderscheiden ruimten;
  - de ligging van de bedrijfsriolering;
  - de plaats van de lozingspunten.
- Situatieschets van het bedrijf en in de omgeving gelegen gebouwen (schaal minimaal 1:10.000 en een noordpijl) *

Gegevens bevoegd gezag

Gemeente Arnhem p/a Omgevingsdienst Regio Arnhem, Advies en Ondersteuning Postbus 3066 6802 DB Arnhem
Rijkswaterstaat Servicecenter vergunningen Postbus 4142 6202 PA Maastricht

Referentie melding

Deze melding is bij ons bekend als **AIM-sessie Avkg8bul34t**. Wilt u alstublieft, als u schriftelijk of mondeling contact zoekt, dit als referentie vermelden?

Datum en tijdstip melding

Deze melding is gemaakt op 28-02-2017 om 16:49 uur.

VII

BIJLAGE : GELIJKWAARDIGHEIDEISEN BOUWBESLUIT EN DNVGL-ST-0145 STANDAARD VOOR OFFSHORE SUBSTATIONS

Voor wie het aangaat

DNV GL - Energy

Tel: +31 26 356 6393
E-mail:

Datum:	**Onze referentie**:	**Uw referentie**:
2017-02-15	138835-R&S/RES 17-0241	--

Betreft: Gelijkwaardigheideisen Bouwbesluit en DNVGL-ST-0145 standaard voor Offshore substations

Inleiding

TenneT heeft de intentie om voor de windparken in de kavels Hollandse Kust (zuid) een van de twee toe te passen offshore platforms te bouwen binnen de 12-mijlszone. Dit platform Beta bevindt zich daarmee in de territoriale zee (TZ).

Rijkswaterstaat heeft als bevoegd gezag aangegeven dat voor de bouw in de territoriale zee een omgevingsvergunning bouw dient te worden aangevraagd. Het Bouwbesluit is daarmee van toepassing.

Buiten de 12-mijlszone worden de bouwkundige eisen waaraan een installatie in de TZ moet voldoen opgenomen in de Watervergunning waarin de Offshore Veiligheidsvoorschriften zijn opgenomen. Er wordt niet getoetst aan het Bouwbesluit. Er wordt geen omgevingsvergunning bouw verleend. Die is voor het binnen de 12-mijlszone gelegen platform Beta echter wel vereist. Uit correspondentie met het bevoegd gezag is duidelijk geworden dat de vergunningaanvrager (TenneT) een aanvraag omgevingsvergunning kan indienen en daarin kan verzoeken de Offshore Veiligheidsvoorschriften en andere bouwvoorschriften die als standaard zijn geformuleerd door DNV GL als gelijkwaardige maatregel te mogen treffen.

De vergunningaanvrager dient daarbij te toetsen of de voorschriften en standaarden gelijkwaardig zijn aan de gestelde eisen. Op basis hiervan beoordeelt het bevoegd gezag (RWS ZD) vervolgens of de bouwstandaarden inderdaad gelijkwaardig zijn. Indien dit zo is kan vervolgens de omgevingsvergunning bouw worden verleend.

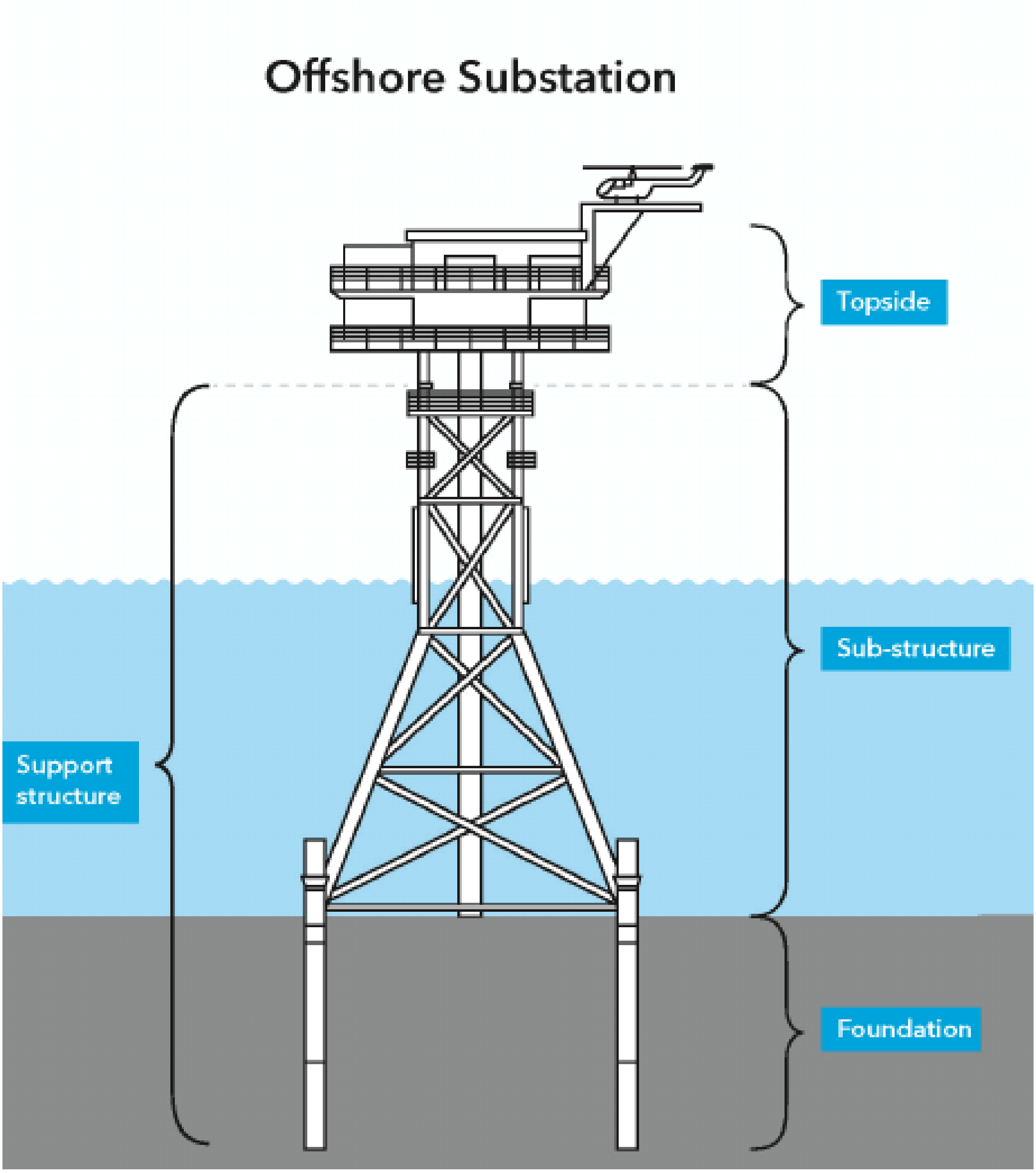
DNV GL certificeringsysteem

TenneT heeft aangegeven dat het van plan is om gebruik te maken van projectcertificatie volgens DNV GL-SE-0190 of gelijkwaardig. DNV GL zal voor de twee platforms die in Borssele geplaatst worden de certificering voor TenneT volgens dit systeem uitvoeren en treedt daarbij op als onafhankelijke deskundige. Daartoe is DNV GL als certificerende instantie geaccrediteerd door de desbetreffende accreditatiecommissie.

Voor Hollandse Kust (zuid) is op dit moment nog geen certificerende instantie gecontracteerd. Wel zal de projectcertificering voor Hollandse Kust (zuid) ook volgens DNVGL-SE-0190 of gelijkwaardig plaatsvinden.

Het doel van projectcertificering volgens DNVGL-SE-0190 is ervoor te zorgen dat een windpark (en andere installaties die daar deel van uitmaken) veilig en kosteneffectief worden bedreven, veiligheidsrisico's worden gemitigeerd en dat aan alle technische-, ontwerp- en constructie-eisen wordt voldaan.

Het certificeringschema volgens SE-0190 is ontworpen en toepasbaar voor alle gebruiksfasen van het platform. Het vormt een robuuste manier om door onafhankelijke certificering aan te tonen aan belanghebbenden dat voldaan is aan een set van eisen vastgelegd in de standaarden, dat wil zeggen tijdens de ontwikkeling en bouw, en ook tijdens het bedrijven van het platform.



Figuur 1 Opbouw van offshore platform

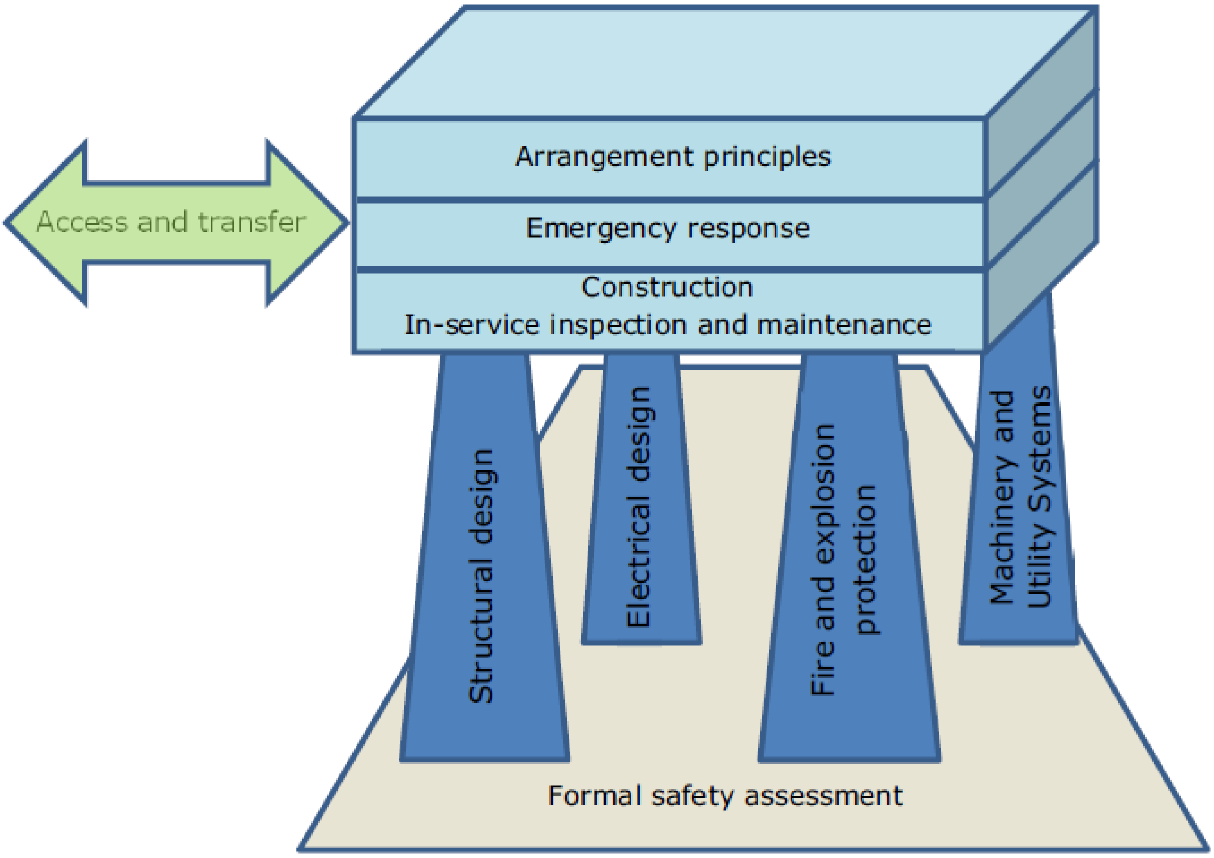
Voor een platform (substation) bestaat het certificeringsproces uit het afgeven van de Statements of Compliance voor topside en support structure volgens Tabel 2.

Tabel 1 Fasering projectcertificering en Statements of Compliance

Project certificering	Resultaat/Statement of Compliance
Design basis	Geaccepteerd overzicht van - site condities - standaarden en wettelijke eisen - ontwerpmethodes
Design	Het ontwerp beslaat alle noodzakelijke stappen om tot een Final Design Approval te komen. Dit bevat een geaccepteerde locatiespecifieke Design Approval van het platform
Manufacturing	Het productieproces voldoet aan de kwaliteitseisen
Transport and Installation	Transport- en Installatieproces zijn zodanig dat de belastingen binnen de ontwerpgrenzen blijven
Commissioning Operation and Maintenance	Het platform voldoet aan alle criteria Alle tekeningen en handleidingen zijn geaccepteerd
Final Evaluation Report	Project Certificate platforms

Bij het certificeringsproces wordt gebruik gemaakt van DNVGL-ST-0145 standaard voor Offshore platforms. Deze standaard is de opvolger van de DNV-OS-J201 die gebruikt is voor certificering van platforms bij een groot aantal windparken in de UK, Denemarken, België en Nederland. De revisie houdt verband met de fusie tussen DNV en GL in 2013.

De standaard is specifiek bedoeld voor AC-offshore platforms (zoals door TenneT in Nederland op dit moment zijn voorzien) en bevat de onderwerpen elektrisch ontwerp, veiligheidsaspecten met betrekking tot lay-out, brand- en explosieveiligheid en respons tijdens calamiteiten. Verder behandelt de standaard structural design, geotechniek, materialen en fabricage voor zover deze aspecten uniek zijn voor platforms. Waar mogelijk wordt verwezen naar toepasselijke DNV GL-standaarden of overige normatieve referenties.



Figuur 2 Inhoud van DNV GL standaard

In de standaard wordt gebruik gemaakt van een systematisch proces voor het identificeren van gevaren en risico's. De start van het proces is het definiëren van de veiligheidsfilosofie die leidend is voor alle fases tijdens de levensduur van het platform. Voor een AC-platform kan aan de eisen van de veiligheidsfilosofie meestal worden voldaan door het toepassen van voorschriften aangevuld met een HAZID-based risico-inventarisatie om ervoor te zorgen dat aanvullende risico's die niet worden gedekt door voorschriften toch worden meegenomen. Wanneer restrisico's worden geïdentificeerd leidt dit tot een herontwerp of tot mitigerende maatregelen. Voor het tegengaan van menselijke fouten wordt een kwaliteitsmanagementsysteem vereist. Een goed interfacemanagementsysteem zorgt ervoor dat tijdens het ontwerpproces vertrouwd kan worden op de data die wordt uitgewisseld tussen de verschillende partijen.

Eisen die aan het ontwerpproces worden gesteld zijn:

- Bij het TenneT platform is sprake van een Type A-platform, dat wil zeggen een hoogspanningsstation, waar alleen gedurende de dag personeel aanwezig is voor inspectie- en onderhoudswerkzaamheden.
- Bij de indeling van het platform wordt een scheiding aangebracht in zones met een hoger en een lager risico. Gevaarlijke zones worden gescheiden van werk- en accommodatieruimtes.
- Voor het structureel ontwerp wordt uitgegaan van een High Safety Class; falen kan grote consequenties hebben voor personen, significante vervuiling, maatschappelijke schade of grote economisch consequenties. Dit houdt in dat het platform wordt ontworpen met een faalkans van 10^{-5} per jaar.

Om te voldoen aan de eis dat de constructie de omgevingscondities van wind, golven en stroming moet kunnen weerstaan, wordt een design basis vereist. Deze design basis legt vast:

- Basisgegevens van het platform
- Meteorologische en oceanografische condities
- Geotechnische condities
- Hoofdeigenschappen van de staalconstructie
- Topside eigenschappen (dekken, interfaces, geometrie, toegangsroutes, constructieve elementen, materialen, fabricagetechnieken)

Bij het ontwerpproces worden de volgende aspecten beoordeeld:

- Constructief ontwerp
- Elektrisch ontwerp
- Brand- en explosieveiligheid
- Hulpsystemen
- Toegang en transfer van personeel
- Emergency response
- Constructie
- Onderhoud en bediening

Toetsing aan het Waterbesluit

Tot nog toe is de vergunning tot bouw gebaseerd op de Waterwet (Wtw) en het Waterbesluit (Wtb). Conform artikel 6.5 van het Waterbesluit is het verboden zonder daartoe strekkende vergunning (...) installaties (...) te plaatsen in de territoriale zee. Dit verbod is niet van toepassing op windparken op zee (art. 6.5a Wtw) waarop de wet windenergie op zee van toepassing is.

In het Waterbesluit worden in paragraaf 6a de eisen waaraan een windpark op zee moet voldoen verder uitgewerkt. Deze eisen zijn van toepassing in de territoriale zee en de Nederlandse exclusieve economische zone.

Volgens artikel 6.16d van het Waterbesluit dient de exploitant ten minste acht weken voor de aanvang van de bouwperiode aan de Minister het voornemen tot oprichten van een windpark te melden en onder andere aan te leveren

- (1c) een verklaring aan te leveren van een onafhankelijke deskundige dat het ontwerp van de windturbines en **andere installaties die deel uitmaken van het windpark** voldoet aan de in artikel 6.16g, eerste lid Wtb gestelde eisen;

De eisen die in het Wtb zijn gesteld golden in eerdere omstandigheden voor het windpark, het platform en de exportkabel. Met de aanwijzing van TenneT als netbeheerder op zee is de situatie gewijzigd en worden windpark enerzijds en platforms en exportkabels anderzijds aparte vergunningen. Formeel zijn er nu geen aparte eisen gesteld aan het platform, maar het is voor de hand liggend om hiervoor de eerder gestelde eisen te gebruiken, als ware het **een andere installatie die deel uitmaakt van een windpark**.

In artikel 6.16g Wtb worden de volgende eisen gesteld:

1. *Een windturbine **alsmede een andere installatie die deel uitmaakt van een windpark** is voldoende sterk om de als gevolg van windsterkte, golfslag, zeestroming en gebruik van de turbine te verwachten krachten te weerstaan.*
2. *De exploitant verstrekt ten minste vier weken voor de ingebruikname van het windpark aan Onze Minister een verklaring dat de constructie en de bouw van de **windturbines en andere installaties die deel uitmaken van het windpark** voldoen aan het eerste lid.*
3. *Een verklaring als bedoeld in het tweede lid wordt opgesteld door een onafhankelijke deskundige die toetst aan een in de praktijk beproefd stelsel van normen die betrekking hebben op het ontwerp van installaties in een windpark.*
4. *Bij ministeriële regeling kunnen regels worden gesteld over de inhoud van een verklaring als bedoeld in het tweede lid.*

Formeel maakt het platform van TenneT geen deel uit van het windpark, maar deze eisen zijn bruikbaar op het TenneT platform. Door toepassing van het DNV GL-certificeringsproces en de bijbehorende standaarden, wordt voldaan aan deze eisen en wordt een veilig en betrouwbaar platform gerealiseerd.

Toetsing aan het Bouwbesluit

Het Bouwbesluit beschrijft technische bouwvoorschriften uit oogpunt van veiligheid (afdeling 2) die ook worden behandeld in de DNVGL-ST-0145 standaard. In art 3.1 (Gelijkwaardigheidsbepaling) wordt gesteld:

1. *Aan een in hoofdstuk 2 tot en met 7 gesteld voorschrift behoeft niet te worden voldaan indien het bouwwerk of het gebruik daarvan anders dan door toepassing van het desbetreffende voorschrift ten minste dezelfde mate van veiligheid, bescherming van de gezondheid, bruikbaarheid, energiezuinigheid en bescherming van het milieu biedt als is beoogd met de in die hoofdstukken gestelde voorschriften.*
2. *Een gelijkwaardige oplossing als bedoeld in het eerste lid wordt bij het gebruik van het bouwwerk in stand gehouden.*

Kwalitatief worden deze eisen uitgewerkt in de Aansturingsartikelen van de verschillende afdelingen van het Bouwbesluit.

In Tabel 1 wordt een systematische vergelijking gepresenteerd van de technische bouwvoorschriften uit oogpunt van veiligheid (afdeling 2) en de relevante onderdelen van de DNVGL-ST-0145 standaard. Daarbij wordt aangetekend dat wettelijke eisen in de Design Basis van het ontwerp dienen te zijn opgenomen en dat de standaard daar vervolgens ook aan toetst.

Door certificering van het ontwerp tegen de DNVGL-ST-0145 worden systematisch alle bouwvoorschriften van het Bouwbesluit behandeld.

Tabel 2 Vergelijkingstabel Bouwbesluit en DNVGL-ST-0145 standaard

Bouwbesluit	Korte omschrijving	DNVGL-ST-0145	Korte omschrijving
2 Veiligheid			
2.1 Algemene sterkte van de bouwconstructie	Voldoende bestand tegen daarop werkende krachten. Bezwijkt niet gedurende levensduur aan (i) fundamentele belastingcombinaties (ii) buitengewone belastingcombinaties (NEN-EN 1990) volgens NEN-EN 1991. Bezwijken wordt bepaald volgen NEN-EN 1999 of NEN-EN 1993 bij metalen constructie	4	Beoordeling van ontwerp op basis van DNVGL-ST-0145. Ontwerpsuitgangspunten zijn vastgelegd in de design basis. Beoordeeld wordt ontwerpfilosofie en safety level. Platform en fundering voldoen aan hoogste veiligheidsklasse (10^{-5} falen per jaar). Toetsing op Ultimate, Service, Fatigue en Accidental Limit State tijdens hele levensduur van het platform
2.2 Sterkte bij brand	Platform kan bij brand gedurende redelijke tijd worden verlaten en doorzocht. Vloer, trap of hellingbaan op de vluchtroute bezwijkt niet binnen 30 min. Bouwconstructie hoger of dan 5m onder een meetniveau bezwijkt niet binnen 90 min (60 min bij een vuurbelasting <500 MJ/m^2). Bezwijken wordt bepaald volgens NEN-EN 1999 of NEN-EN 1993	6.4.2	Fire and explosion protection design en Emergency Response Design wordt getoetst op relevante standaarden (DNVGL-ST-0145 en nationale wetgeving). Vluchtroutes moeten voldoende beschermd zijn om vluchten en evacuatie mogelijk te maken. Beschermingsduur wordt getoetst aan gebruiksfunctie van de ruimte.
2.3 Afscheiding van vloer, trap en hellingbaan	Voorzieningen tegen vallen van vloer, trap en hellingbaan bij hoogteverschil >1 m (1m, 1,2m bij hoogteverschil >13m, 0,85m bij een raam. Openingen in afscheiding kleiner dan 0,5m, afstand tot afscheiding <0,05m. Geen onderbrekingen >0.1m	7.1.2	Servicebanen, beweegbare platforms, trappen moeten beschermd worden met beschermingsrails van voldoende hoogte uitgerust. Rails vereist bij valhoogte >0.5m hoogte minimaal 1.1m. Teenplaat >0.1m. Afstand tot de rand <0.01m
2.4 Overbrugging van hoogteverschillen	Voorzieningen voor veilig overbruggen van hoogteverschillen door personen noodzakelijk bij hoogteverschil >0,21m op vluchtroute en tussen gebruiksgebieden	8.5	Hoogteverschillen worden overbrugd door trappen. Liften zijn niet acceptabel op vluchtroutes.
2.5 Trap	Trap dient veilig te kunnen worden gebruikt. Trap heeft minimale afmetingen (tabel 2.33). Trapbordes is minimaal 0,8mx0,8m Trappen >1m hebben een leuning	8.5.2.5	Trappen en platforms worden ontworpen volgen ISO 14122
2.6 Hellingbaan	Hellingbaan dient veilig te kunnen worden gebruikt Hellingbaan heeft een breedte >1,1m, hoogte <1m en een maximale hellingshoek Hellingbaanbordes > 1,4mx1,4m Geleiderand >0,04m	8	Ontworpen volgen ISO 14122
2.7 Beweegbare constructiedelen	Beweegbare constructiedelen hinderen niet bij vluchten door en bij gebruik van aangrenzende openbare ruimte. Beschermde vluchtroute heeft een vrije doorgang bij geopend beweegbaar constructiedeel breedte>0,6m en hoogte>2,2m	9	Voor certificering dient een Emergency response analyse worden gemaakt waar toegankelijkheid van vluchtwegen een onderdeel van is.

2.8 Beperking van het ontstaan van een brandgevaarlijke situatie	Ontstaan van brandgevaarlijke situaties wordt voldoende beperkt. Materiaal aan binnenzijde van schacht, koker of kanaal grenzend aan (sub)brandcompartiment > 0,015m² voldoet aan brandklasse A2 (NEN-EN13501-1) Rookgasafvoervoorziening is brandveilig (NEN 6062). Open verbrandingstoestel ligt niet in toiletruimte, badruimte of garage.	6.	Fire and explosion protection wordt getoetst aan veiligheidfilosofie en ontwerpprincipes. Schachten en ventilatiekanalen worden uitgerust met een stalen bescherming.
2.9 Beperking van het ontwikkelen van brand en rook	Bouwwerk is zodanig dat brand en rook zich niet snel kunnen ontwikkelen. Constructieonderdelen voldoen aan de in tabel 2.66 aangegeven brandklasse en rookklasse (NEN-EN 13501-1). Bovenzijde van een dak is niet brandgevaarlijk.	6.2	Doel van fire and explosion protection is om ervoor te zorgen dat: - Voldoende tijd is voor veilig evacueren van personeel - Minimaliseren van risico op vuur en explosies - Automatisch gas en vuurdetectie - Overdruk aflaten - Brand controleren en beperken van schade en escalaties - Voor (on)bemande installaties elimineren van typische brand scenario's dmv actieve en passieve brandbescherming. Constructieonderdelen voldoen aan tabel 6-1. (DNVGL-ST-0145 section 6.4.2)
2.10 Beperking van uitbreiding van brand	Kans op snelle uitbreiding van brand dient voldoende te worden beperkt. Een besloten ruimte ligt in een brandcompartiment (uitgezonderd toiletruimte, badruimte, liftschacht voldoende brand- en rookwerend, technische ruimte <50m² met verbrandingstoestel <130kW). Extra beschermde vluchtroute bevindt zich niet in brandcompartiment. Open gebruiksgebied ligt in brandcompartiment. Uitzondering gebruiksfunctie <1000m², permanente vuurbelasting <150 MJ/m² (NEN 6090) Brandcompartiment <2500 m². Weerstand tegen branddoorslag en brandoverslag van brandcompartiment naar een ander brandcompartiment, naar besloten ruimte met extra beveiligde vluchtroute, niet besloten vluchtroute en naar liftschacht van een brandweerlift is >60 min. (NEN 6068). Soms kan worden volstaan met 30 min.	6.4.2	Kans op snelle uitbreiding van brand dient voldoende te worden beperkt. Besloten ruimtes liggen zoveel mogelijk verwijderd van brandgevaarlijke plaatsen. Gebruiksruimtes worden gescheiden door wanden met voldoende bescherming (tabel 6-2, DNVGL-ST-0145 section 6.4.2).
2.11 Verdere beperking van uitbreiding van brand en beperking van verspreiding van rook	Uitbreiding van brand wordt in verdergaande mate beperkt dan is beoogd in 2.10.	6	Overige middelen ter beperking van brand

2.12 Vluchtroutes	Bij brand kan een veilige plaats worden bereikt. Op elk punt van een voor personen bestemd gebied begint een vluchtroute die leidt naar het aansluitende terrein en vandaar naar de openbare weg. Afstand naar uitgang subcompartiment <30m (bij minder dan 1 persoon per 12m^2 45m, 1 per 30m^2 60 m). Een beschermde vluchtroute (minder dan 37 personen) is noodzakelijk tenzij de uitgang van het subbrandcompartiment grenst aan het aansluitende terrein Vluchtroute door een trappenhuis hoger dan 8m is een beschermde vluchtroute	9	Emergency response beschrijft de principes, eisen en richtlijnen voor het ontwerp van adequate en effectieve faciliteiten voor een veilige en gecontroleerde calamiteitenrespons. Dit bevat: vluchtroutes, verzamelruimtes die het personeel tijdelijk beschermen, redden van gewonde personen, veilige evacuatie. Via vluchtroutes kunnen verzamelplaatsen worden bereikt die voldoende bescherming bieden tot personen kunnen worden gered. Hiertoe wordt een veiligheidsresponsplanning gemaakt. Hierin worden lokale veiligheidseisen meegenomen.
2.13 Hulpverlening bij brand	Bouwwerk is zodanig dat hulpverlening binnen redelijke tijd personen kan redden en brand kan bestrijden. Vanaf een lifttoegang van een brandweerlift is vanaf een verdieping de lifttoegang op de verdieping daarboven bereikbaar via een extra beschermde vluchtroute. De loopafstand tussen een punt in een gebruiksgebied en ten minste een toegang van een trappenhuis is niet groter dan 75m. De loopafstand tussen een punt in een gebruiksgebied en ten minste een lifttoegang van een brandweerlift is niet groter dan 120 m.	9.2	Layout en procedures van het platform en de prestaties van reddingsinstallaties en procedures (inclusief bevelstructuur en training) worden systematisch gereviewd dmv een vlucht, evacuatie en hulpverleningsanalyse. Dit omvat ook een analyse van de noodstroomvoorziening. Op basis hiervan worden systemen geoptimaliseerd en erop toegezien dat aan de eisen wordt voldaan mbt de volgende systemen: - Noodstroomvoorziening (5.6) - Alarmen en communicatie (9.3) - Shutdown (9.4) - Vluchtroutes (9.5) - Verzamelfaciliteiten en tijdelijk veilige locaties (9.6) - vluchtfaciliteiten (helicopter-hoist, reddingsboten en -vlotten, kraantransport, overig) - Reddingsmiddelen (ERRV, SAR helikopters en schepen in de buurt van de installatie)

Conclusie

Voor het TenneT platform Beta in Hollandse Kust (zuid) is een omgevingsvergunning nodig op basis van de Wet algemene bepalingen omgevingsrecht (Wabo). De eisen waaraan installaties die deel uitmaken van een windpark op zee moeten voldoen zijn omschreven in het waterbesluit. Formeel maakt het platform van TenneT geen deel uit van het windpark, maar deze eisen zijn bruikbaar op het TenneT platform.

Het Bouwbesluit beschrijft technische bouwvoorschriften uit oogpunt van veiligheid (afdeling 2) die ook worden behandeld in de DNVGL-ST-0145 standaard. Door certificering van het ontwerp tegen de DNVGL-ST-0145 worden systematisch alle bouwvoorschriften van het Bouwbesluit behandeld en wordt tenminste dezelfde mate van veiligheid bereikt.

De Offshore Veiligheidsvoorschriften en andere bouwvoorschriften die als standaard zijn geformuleerd door DNV GL kunnen als gelijkwaardige maatregel worden getroffen. Door toepassing van het DNV GL-certificeringsproces en de bijbehorende standaarden, wordt voldaan aan deze eisen en wordt een veilig en betrouwbaar platform gerealiseerd.

TenneT verzoekt dan ook gebruik te kunnen maken van het gelijkwaardigheidsprincipe in het bouwbesluit en de Offshore Veiligheidsvoorschriften en andere bouwvoorschriften die als standaard zijn geformuleerd door DNV GL als gelijkwaardige maatregel te mogen treffen.

Referenties

[1] DNV GL, DNVGL-SE-0190 Project certification of wind power plants, December 2015.

[2] DNV GL, DNVGL-ST-0145 Standard Offshore substations, April 2016.

[3] Waterbesluit, Besluit van 30 november 2009 houdende regels met betrekking tot het beheer en gebruik van watersystemen, 2009.

[4] Waterwet, Wet van 29 januari 2009, houdende regels met betrekking tot het beheer en gebruik van watersystemen, 2009.

[5] Wet algemene bepalingen omgevingsrecht , Wet van 6 november 2008, houdende regels inzake een vergunningstelsel met betrekking tot activiteiten die van invloed zijn op de fysieke leefomgeving en inzake handhaving van regelingen op het gebied van de fysieke leefomgeving, 2008.