Experiencias en:

Sistemas Interconectados de Alta Tension AC & DC

PARAMETROS PRIMARIOS DE LINEA DE TRANSMISION

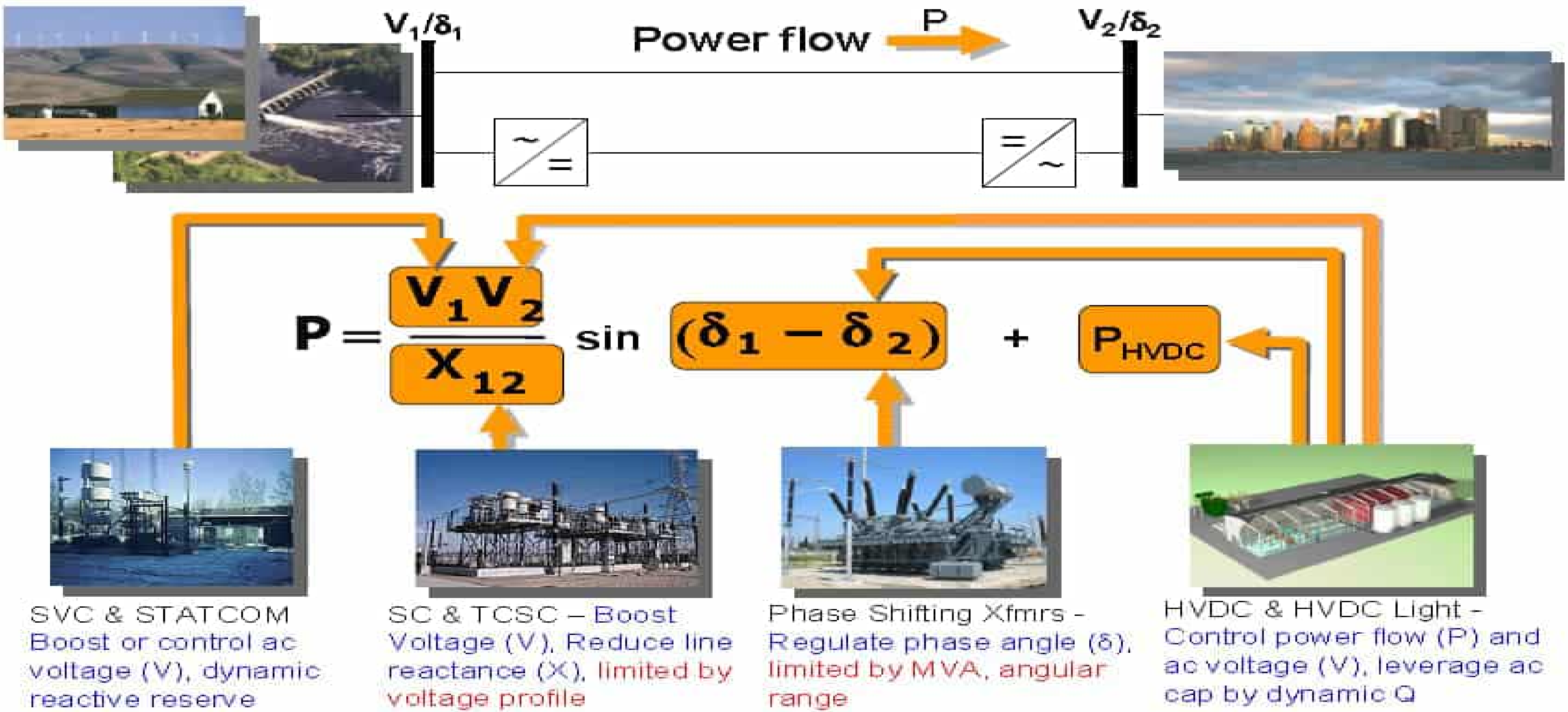
- **Impedancia en Serie: ($Z=R+j\omega L$):** ***Resistencia (R)*** **&** ***Inductancia (L)***
- **Admitancia en Paralelo: ($Y=G+j\omega C$):** **Conductancia (G) & Capacitancia (C)**

- **El perfil de voltaje de una linea de transmission depende principalmente de la distancia, el tipo de carga de la linea y la compensacion.**
- **Limites de Capacidad de Lineas:**
  - ***a) Limite termico: lineas cortas (L<50mi ~ 80 km).***
  - ***b) Regulacion de Voltage: (±5% of Voltaje Nominal) media (50mi ≤ L ≤150mi ~ 241 km).***
  - ***c) Estabilidad & Angulo Oscilacion: Mas comun en lineas largas (>150 mi ~ 241 km).***

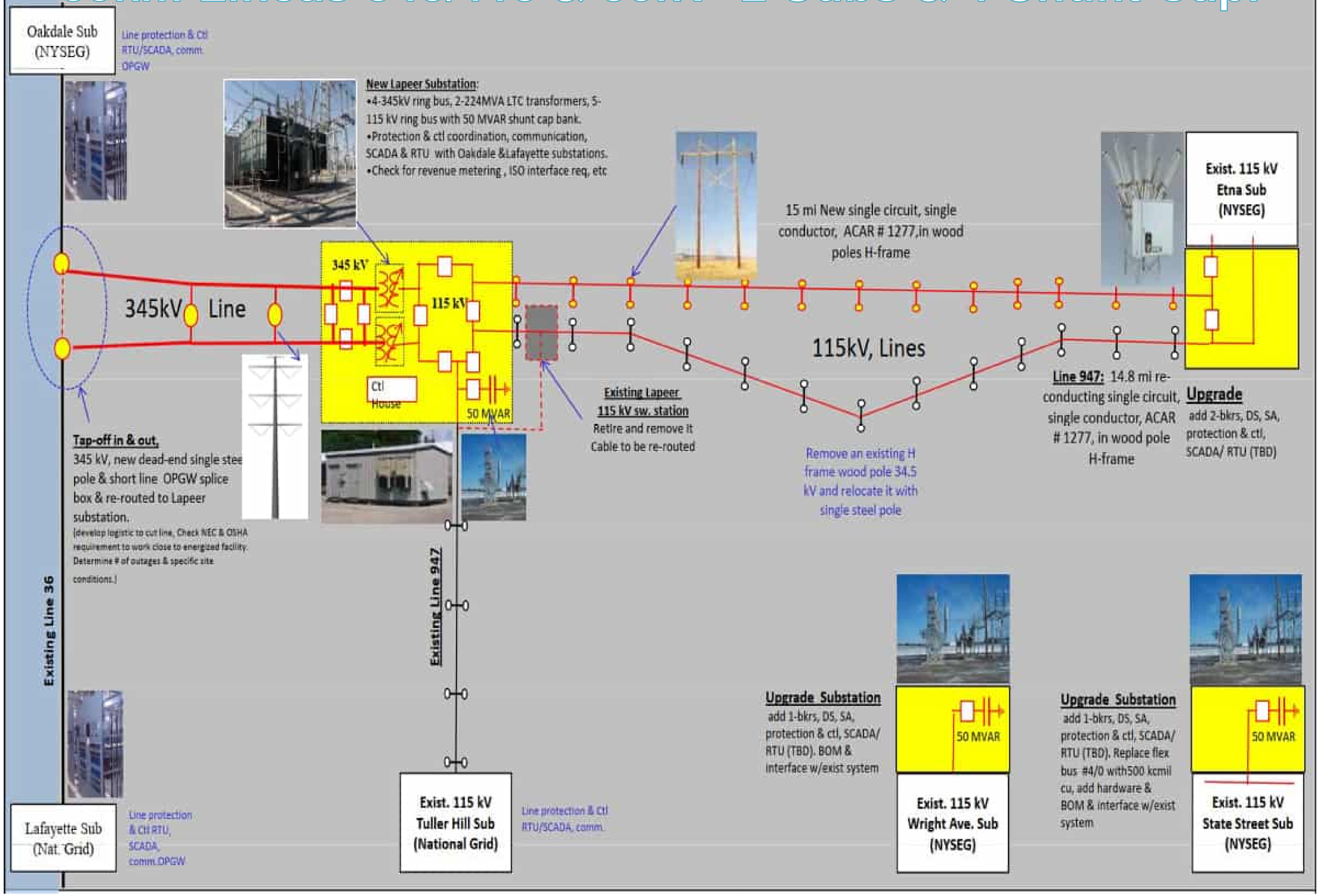
- **El factor principal de inestabilidad se debe a la inabilidad de mantener el balance de potencia reactiva, el control de tensiones y frequencia.**
- **En un sistema interconectado estable, la demanda de potencia activa y reactiva tiene que mantenerse todo el tiempo para evitar colapso de voltaje.**
- **La demanda de potencia reactiva debe satifacerse localmente para maximizar el flujo de potencia activa desde las plantas generadoras para asi minimizar perdidas y mantener una operacion eficiente del sistema.**

Formas de aumentar el fluja de potencia de una linea de transmision:

- ***Repotenciar la linea con conductores mas gruesos y/o mas conductivos***
- ***Operacion dinamica de la linea monitoreando datos climaticos***
- ***Agregar Compensador Estatico Reactivo (SVC o STATCOMS)***
- ***Instalar Capacitores en serie y en paralelo (SCB)***
- ***Emplear transformadores desfasadores (PST)***
- ***Implementar Estacion Convertidoras AC to DC (HVDC)***



60km Lineas 345/115 & 35kV- 2 Subs & 4 Shunt Cap.



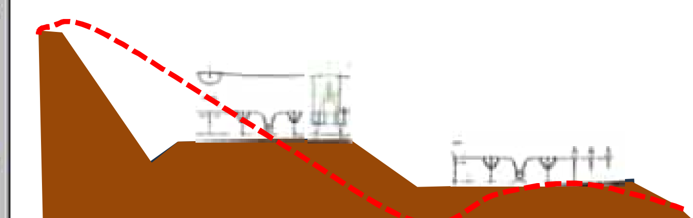
DESCRIPCION PROYECTO EPC

- **Substaciones:**
  - Substacion Clarks Corner Substation: 4-345kV en anillo, 2-224MVA transformadores con LTC and 5-115 kV con cap bank.
  - Modernizar 4 subestaciones 115kV:
    - ***Etna Sub*** *(NYSEG) - add 2-bkrs, DS, SA, protection & ctl, SCADA/ RTU.*
    - ***Weight St*** *(NYSEG) - add 50 MVAR cap bank, bkr, SA, Prot. & ctl, SCADA/ RTU.*
    - ***State St*** *(NYSEG) - add 50 MVAR cap bank, bkr, SA, replace conductors prot & ctl, SCADA/ RTU.*
    - ***Tuller Hill Sub*** *(National Grid) - protection & ctl, SCADA/ RTU.*
- **Lineas deTransmision (**PLS CAD, topografia)

Cortar linea existente (in & out) a nueva subestacion.

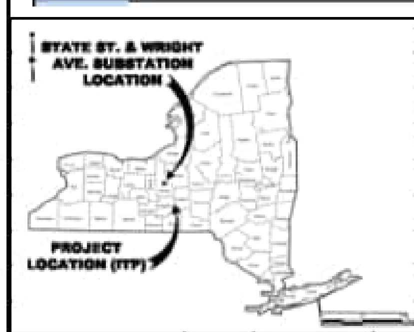
- ✓ **Ingenieria Civil & permisos de Medio hambiente:**
- ✓ **Compra y Suministro de Equipos.**
- ✓ **Administracion de Construccion**
- ✓ **Pruebas y Puesta en Servicio.**

Clarks Corners Substation



New York State Electrical & Gas Corp.

ALCANCE DEL PROJECTO
Sistema de Transmision Ithaca



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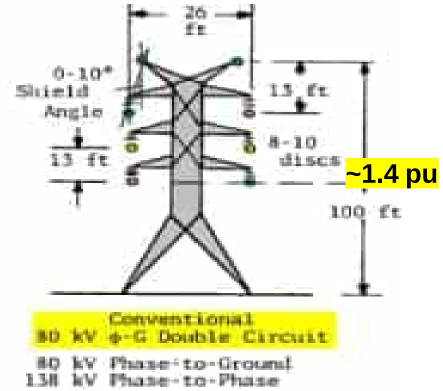
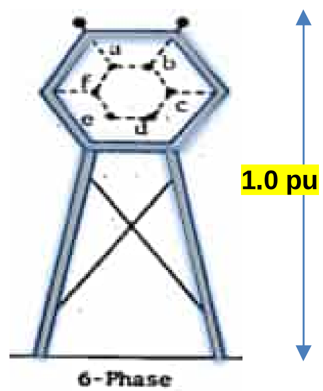
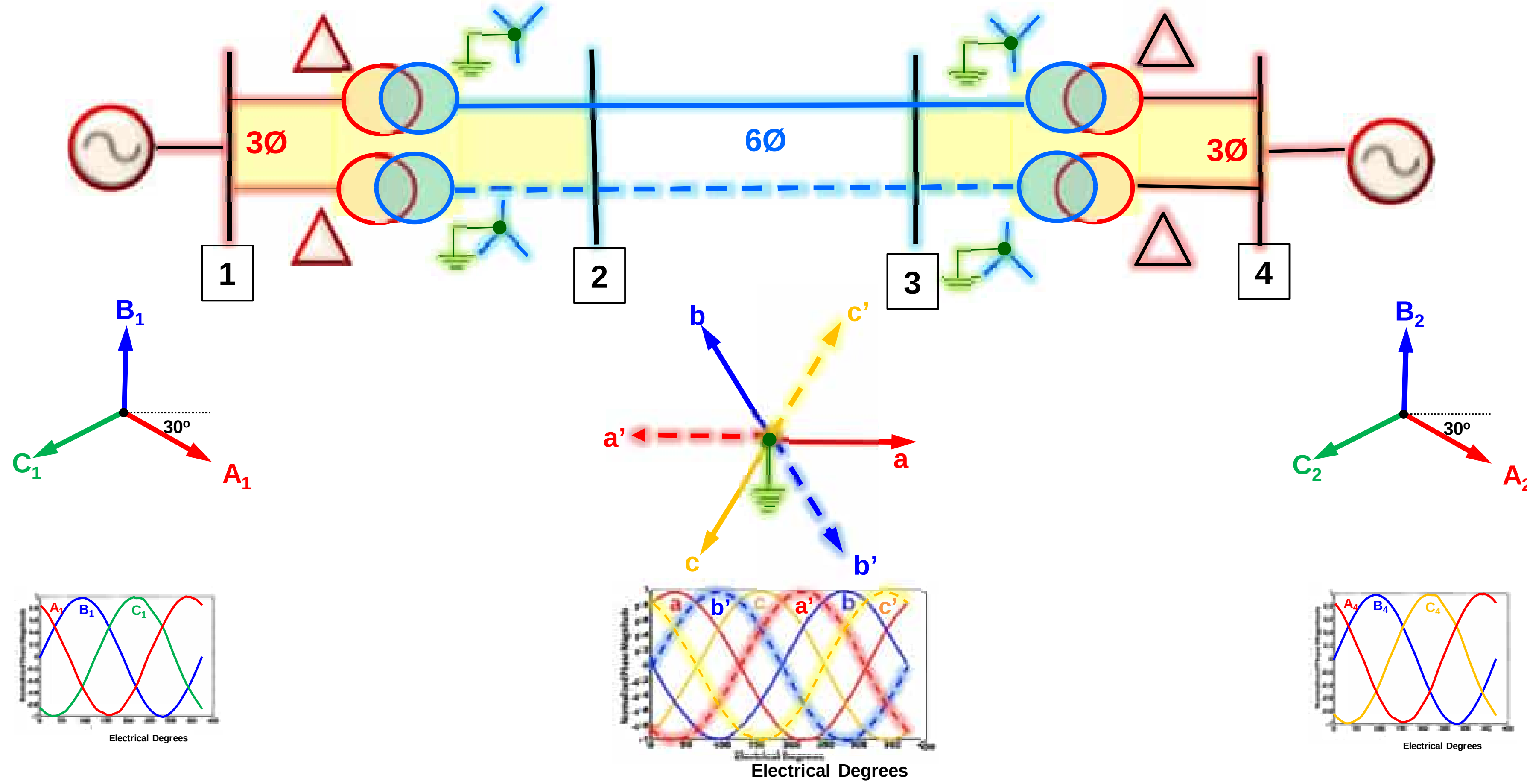
Interconexion Hexafasica







Capacidad de Linea vs. Tension

Tension ØØ Nominal (kV)	Capacity Linea (MW) 3 Phase	6 Phase
69	250	433
115	417	722
138	501	867
230	835	1444
345	1252	2167
500	1815	3140
750	2723	4710

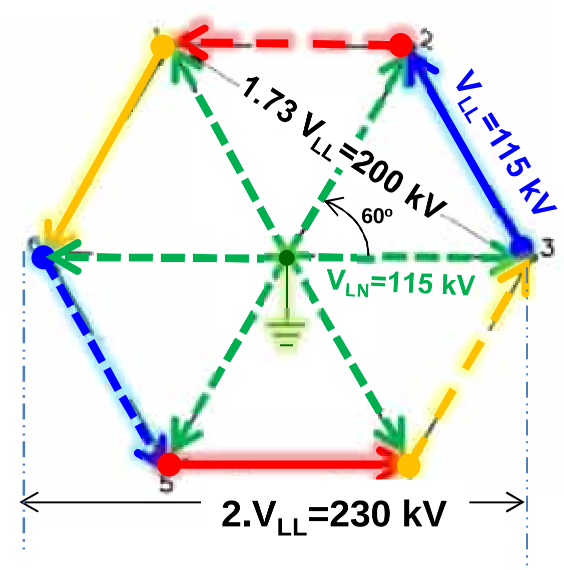
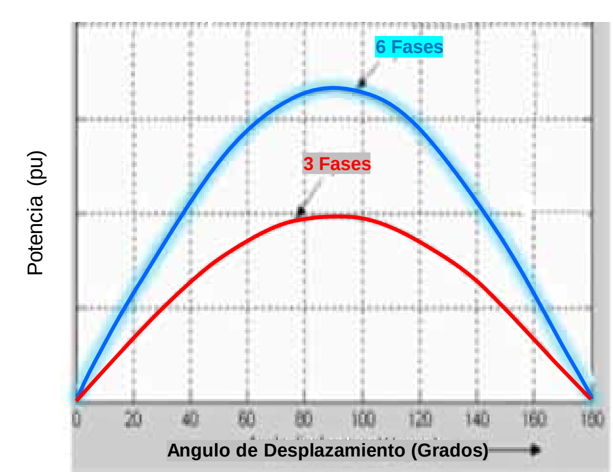


Diagrama Fasorial Hexafasico



Estabilidad Transitoria

- **Principio Basico:** Maximizar la densidad de potential transmitida incrementando el voltaje de fase-tierra hasta el voltaje de fase-fase manteniendo las tensiones de fase-fase de conductores adjacentes sin alterar el calibre del mismo o los aisladores de linea.
- **Resultados:** Elevar la capacidad de Transmision de potencia hasta 73% y reducer costos.
- **Ventajas Adicionales:** Incrementar la capacidad termica de la linea, reducir la diferencia de angulo de fase entre voltajes transmisor y receptor y puede reducir la franja de servidumbre.
- **Desventajas:**
- Experiencia reducida de operacion y mantenimiento.
- Gradiente a tierra mas alto incrementa campo electrico a tierra.
- Sistema de proteccion y control mas complejo.
- Modelaje del Sistema mas dificil.

NYSEG *New York State Electrical & Gas Corp.*

DATOS TECNICOS PARA CONVERSION DE 3 A 6 FACES

EBASCO Electric Bond and Share Company

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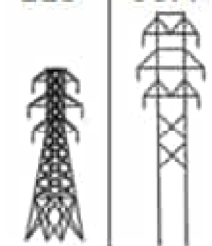
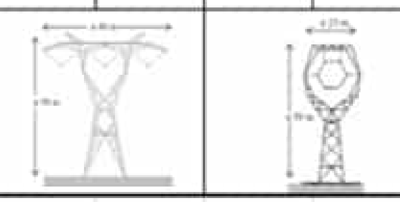
Referencia https://www.eng-tips.com/viewthread.cfm?qid=464382

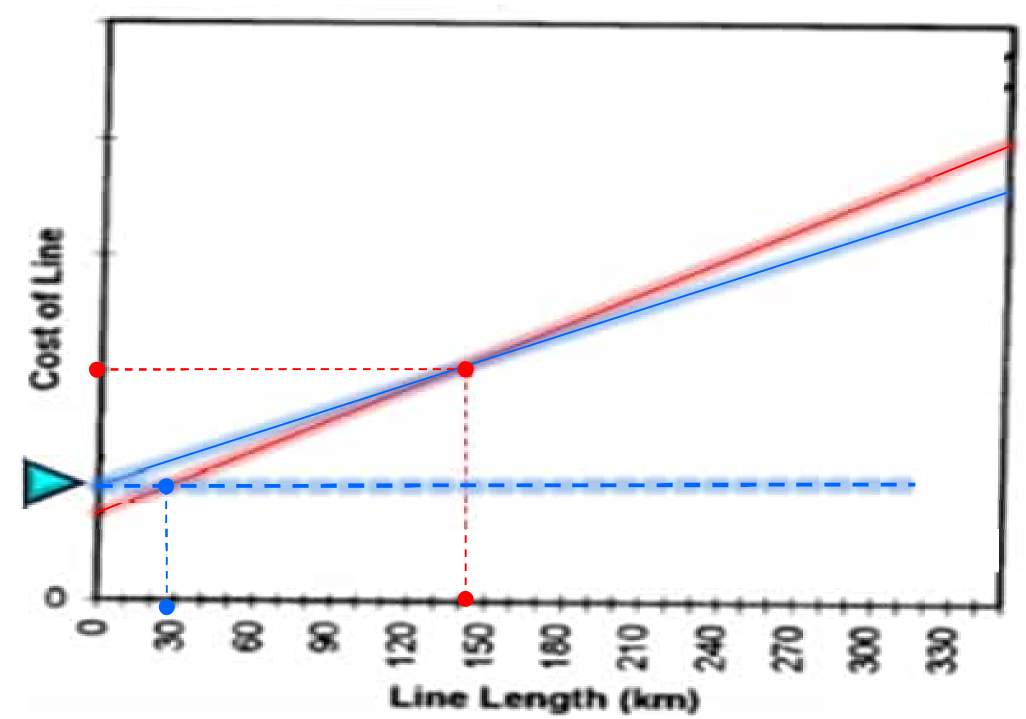
SUMMARY DATA AVAILABLE FOR TWO HIGH PHASE ORDER PROJECTS

αβε's Personal Notes

Item	Reference Project	Utility	Length (mi)	SIL (MW)	+ Sequence (pu)		Exist. 3ØVoltage		New 6ØVoltage		Total Cost / Cost Ratio (6Ø/3Ø)	Line Cost / Cost Ratio (6Ø/3Ø)	Breakeven Distance (mi)	Comments
					R	X	ØØ(kV)	Øn (kV)		ØØ(kV)				
1.1	Goudey-Oakdale (Binghamton, NY-USA) 1992	NYSEG	1.5	72	0.090	0.289	115 	66.4						There is a break-even distance, varying with the particular circumstances, at which six-phase line cost savings overcome higher terminal costs to make six-phase construction an attractive alternative for upgrading an existing double-circuit line. This break-even distance was 23-28 miles for an existing 115-kV double-circuit three-phase line.
1.2				119	0.046	0.174			93	93	$10.9M	0$	28	
1.3				243	0.023	0.085			133	133				
2.0	Camden -Duvha (Mozambique, S. Africa) 1998	ESKOM	62	636	N/A	N/A	400 	230.9	173	173	$531.9 M / 187.6%	$283.5 M / 80.8%	140	*The 6-phase line on the other hand, must have costly terminal equipment installed at both ends of the line for both voltage transformation, and phase shifting. Line feeder bays must be installed for the line side breakers. Currently ESKOM sheading electricity for 12 hours every day.*

SURGE IMPEDANCE AND SIL OF THREE-PHASE AND SIX-PHASE TRANSMISSION LINES

Case name	Surge impedance(Ω)	SIL (MW)
138 kV three-phase double circuit tower line	491.0	78.2
80 kV six-phase conventional tower line	491.0	78.2
80 kV six-phase compact tower line	413.1	93.0
138 kV six-phase conventional tower line	491.0	231.7



$$Z_{6\phi} = \begin{bmatrix} Y_{6self} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6self} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6self} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6self} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6self} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6self} \end{bmatrix},$$

$$\begin{bmatrix} I_{3a1} \\ I_{3b1} \\ I_{3c1} \\ I_{3a2} \\ I_{3b2} \\ I_{3c2} \end{bmatrix} = \begin{bmatrix} Y_{6self} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6self} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6self} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6self} & Y_{6mutual} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6self} & Y_{6mutual} \\ Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6mutual} & Y_{6self} \end{bmatrix} \begin{bmatrix} E_{3a1} \\ E_{3b1} \\ E_{3c1} \\ E_{3a2} \\ E_{3b2} \\ E_{3c2} \end{bmatrix}$$

NYSEG New York State Electrical & Gas Corp.

REVISION APPROVAL RECORD				REV		REV	DATE	REVISIONS	BY	CHKR
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE					
ARCH.			MECHANICAL							
CIVIL			NUCLEAR							
ELECTRICAL			PIPING							
ENVIRON.			PROCESS							
GEN. ARRANG.			QA / QC							
HVAC			STRUCTURAL							
I & C										

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	A	04-25-24		AP
APPROVED FOR CONSTRUCTION				
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED & DATED. DESTROY ALL PRINTS BEARING EARLIER DATE &/OR REV.NO.				

Aditado para Presentacion

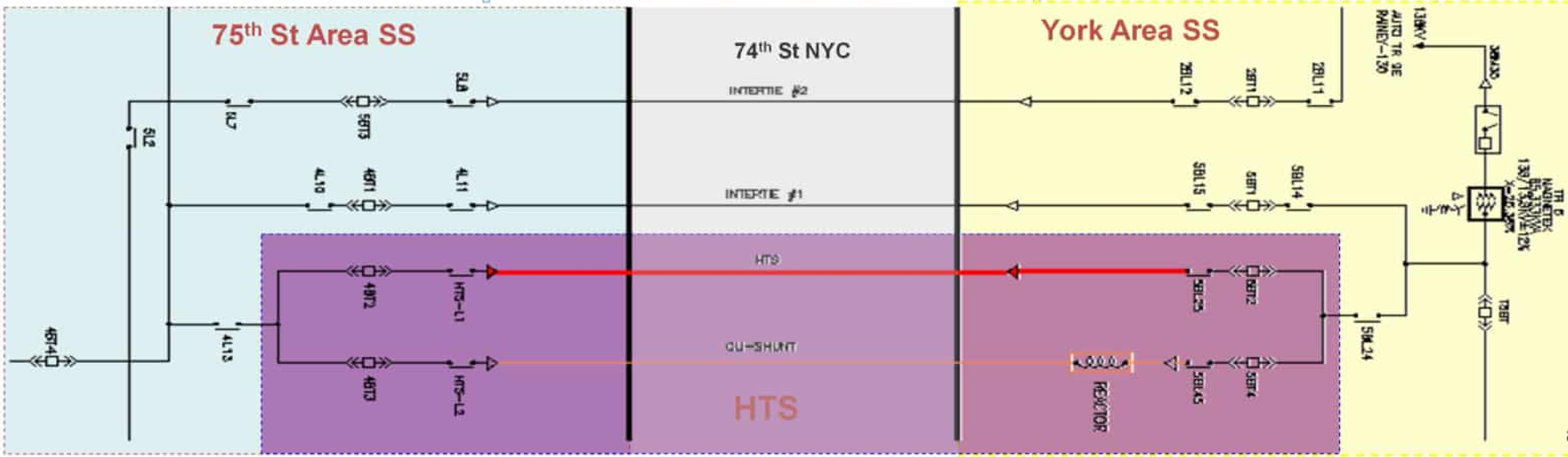
DRN:	DATE:
CHKD:	DATE:
SCALE: NTS	

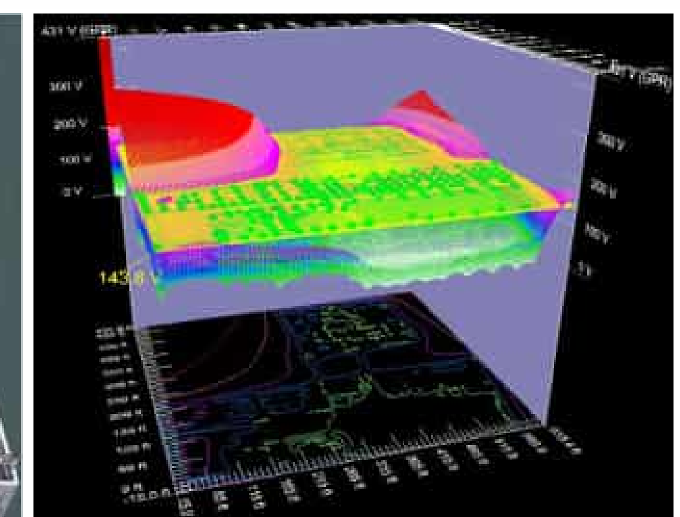
DATOS ECONOMICO INDICATIVO CONVERSION DE 3 A 6 FACES

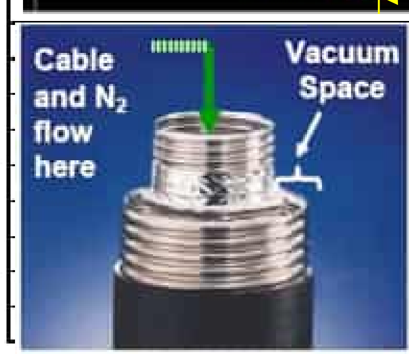
EBASCO Electric Bond and Share Company

SKT No 6 of 12 Abril 25, 2024 REV. A

Interconexion con Superconductor de Alta Temperatura NYC – US$40M







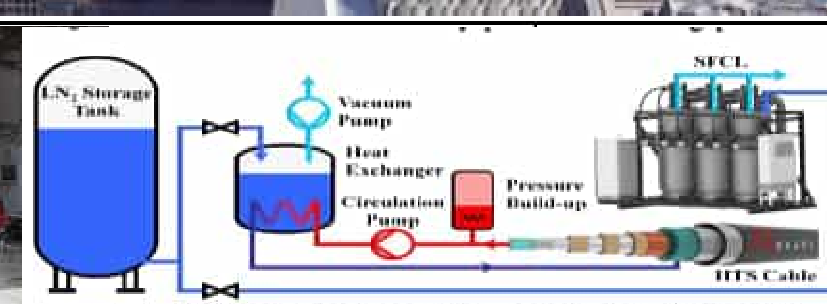


Figure 4 Schematic of cooling system for AmpaCity

Consolidate Edison
Of New York State

Superconductor y Aplicacion en Reduccion de Corriente Corto Circ.

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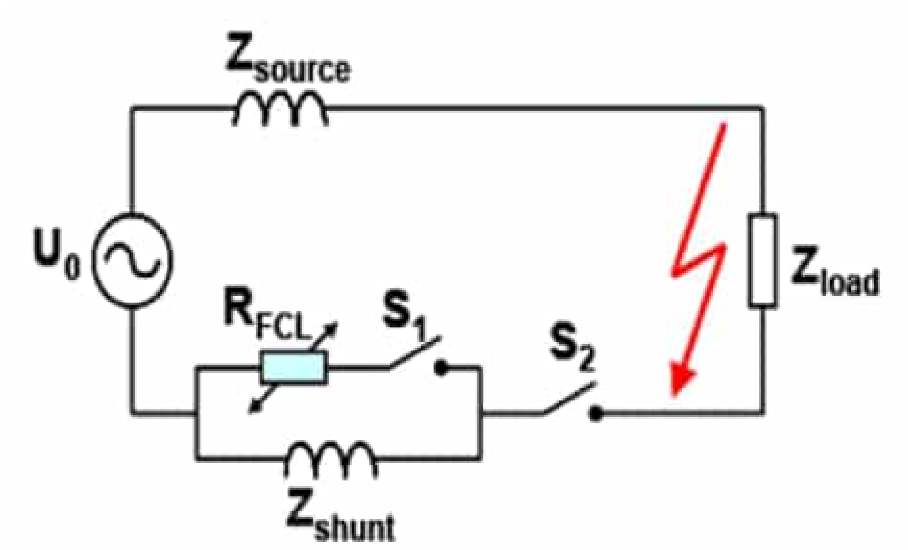


Scheme of a shunted limiter configuration.

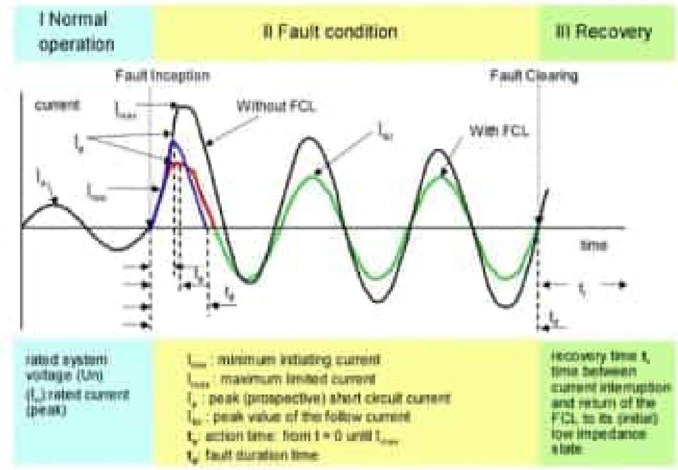
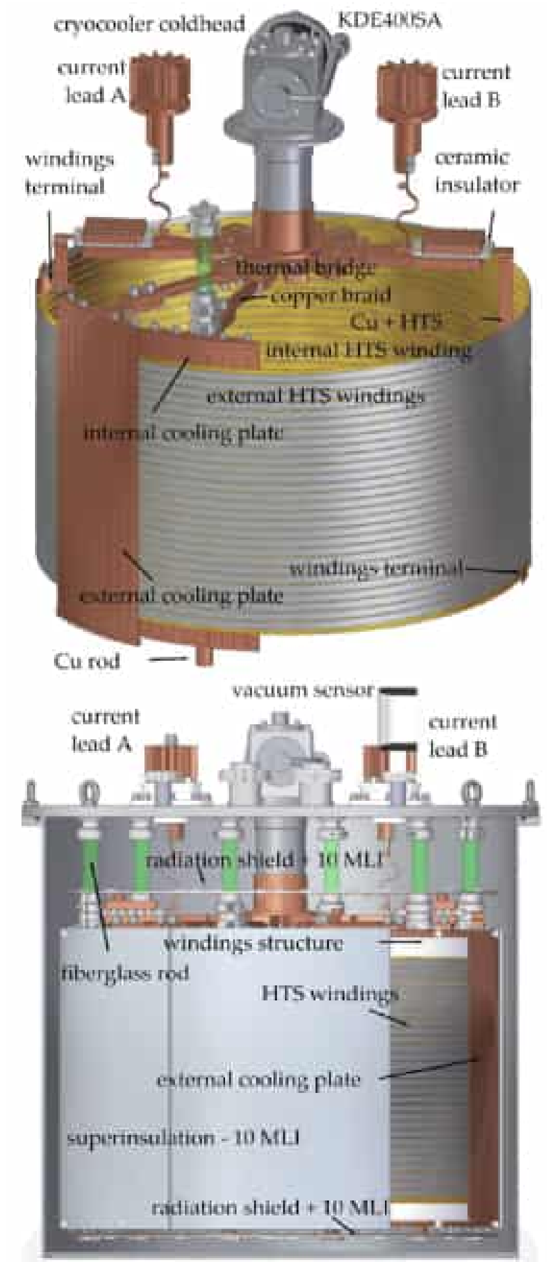
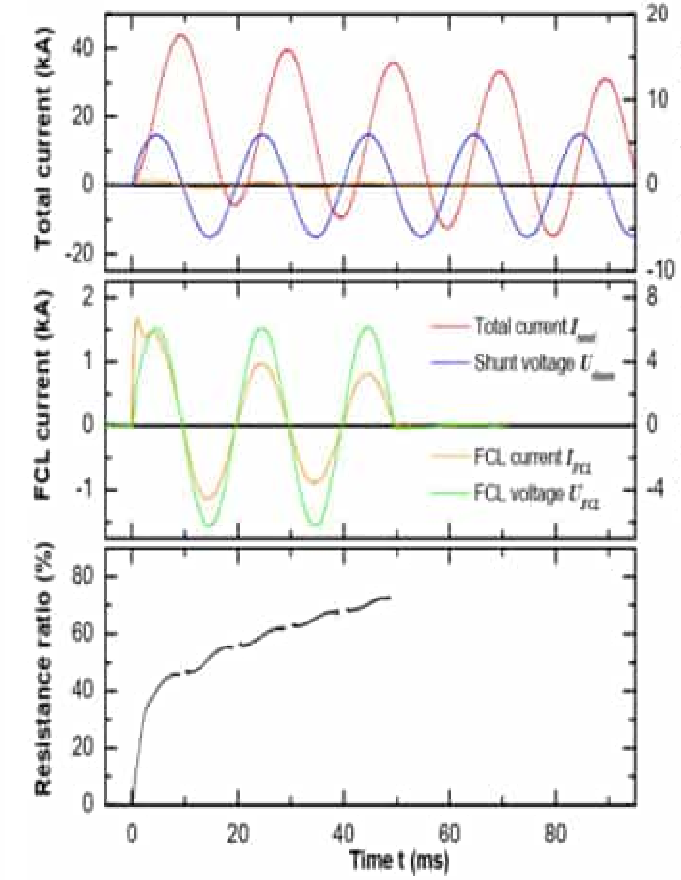
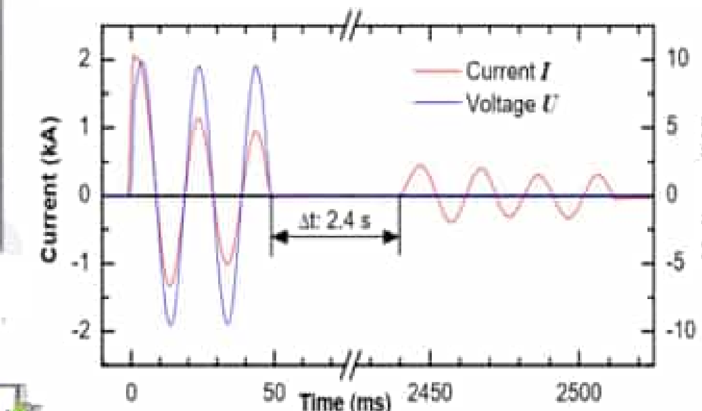


Fig 4.2 operation sequence of SFCL

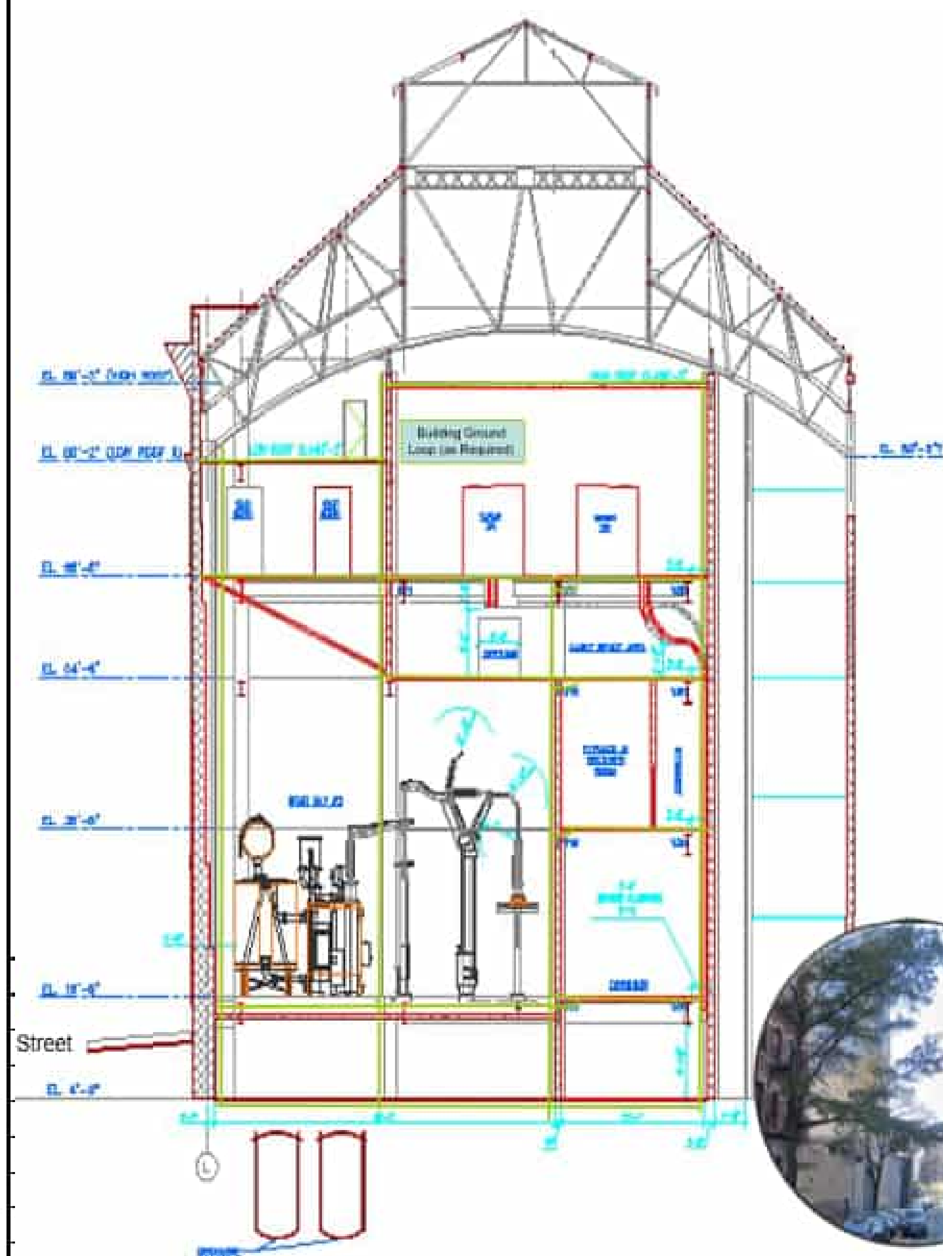


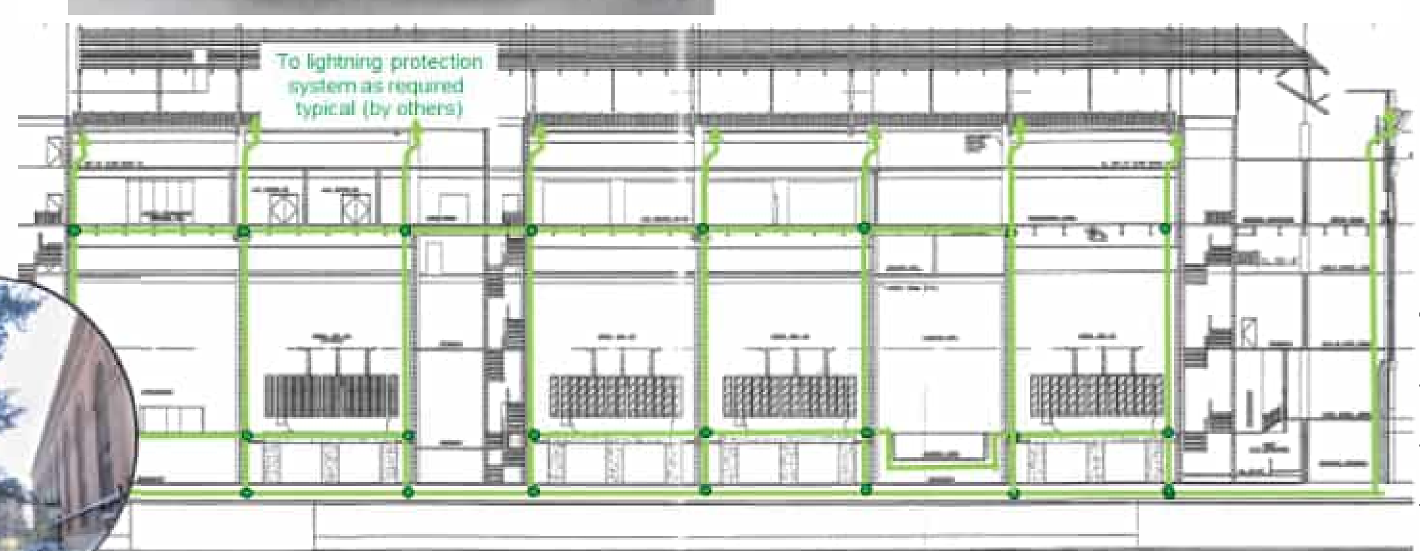


Power test in shunted configuration, U_0: 8.3 kV, I_{prosp}: 34 kA_{rms}, $\phi_{start} = 0°$.



Demonstration of recovery time.





Elevation

Consolidate Edison
Of New York State

Supperconductor y Aplicacion en Reduccion de Corriente Corto Circ.

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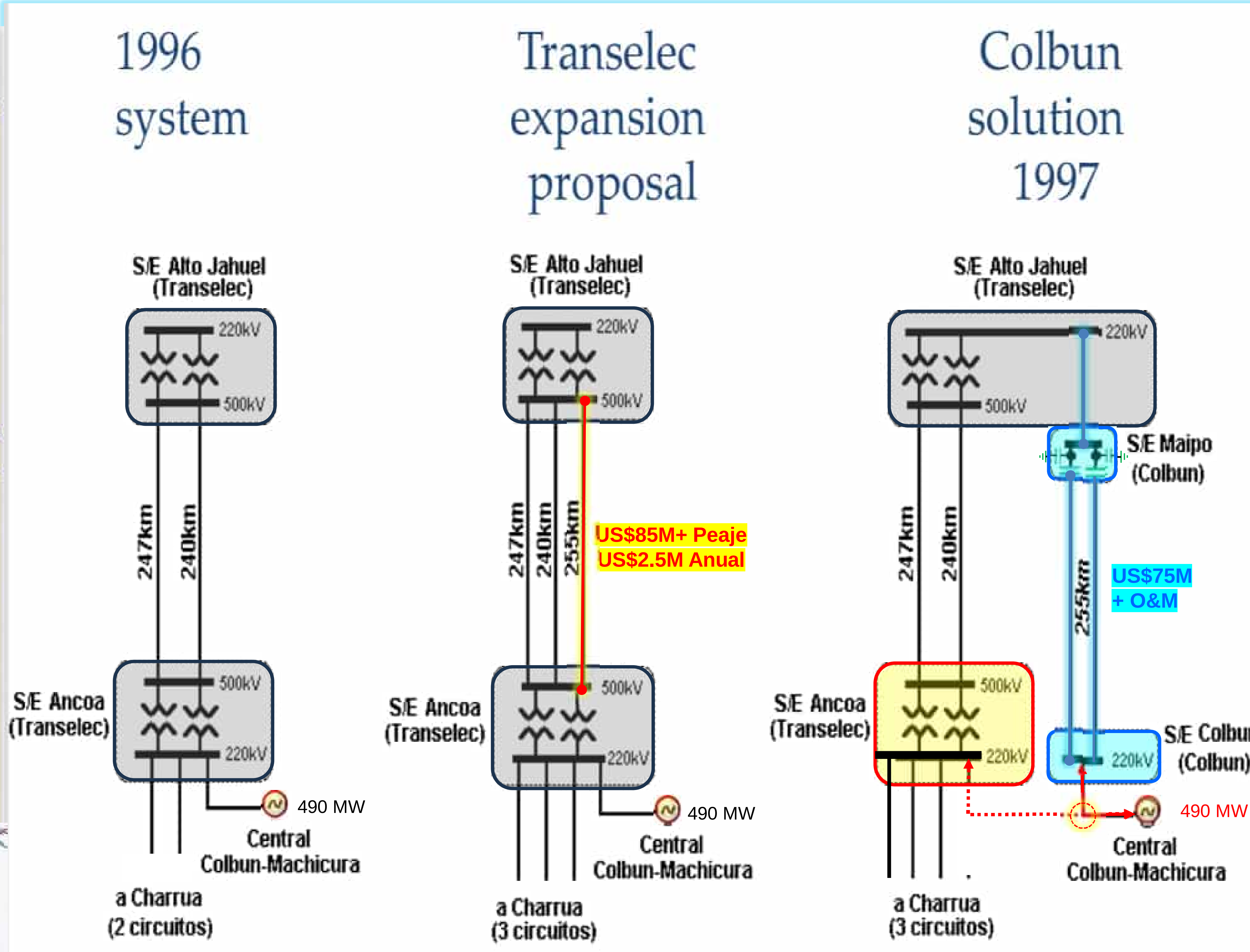
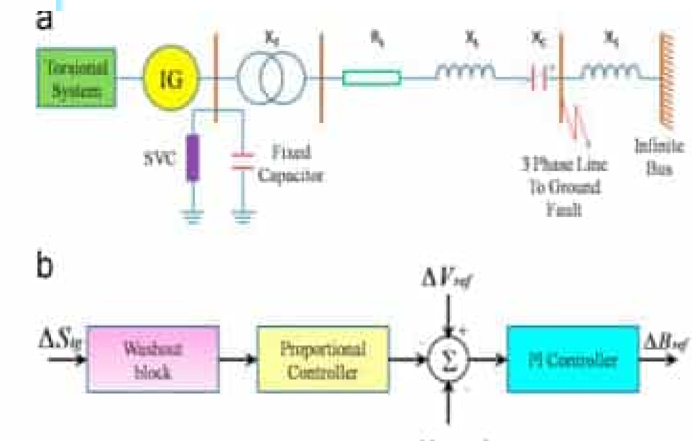
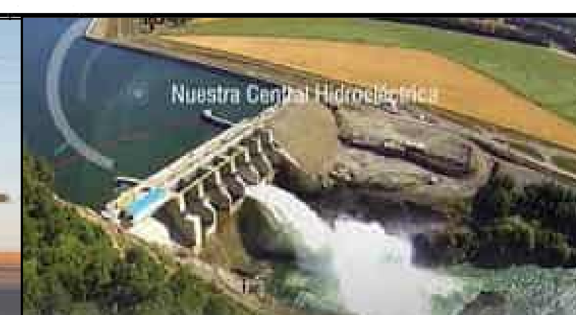
255 km Linea con Compensacion Capacitiva Serie ~US$75M Colbun Chile







Colbun

Supperconductor y Aplicacion de Reduccion de Corriente Corto Circ.

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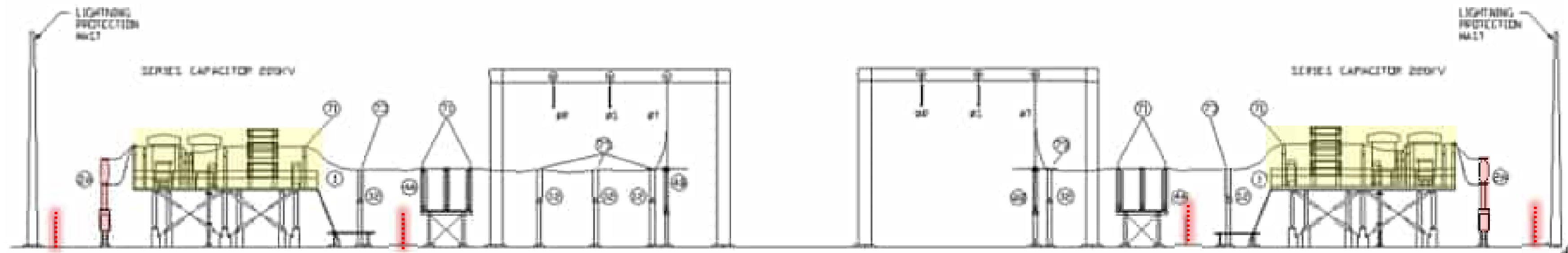
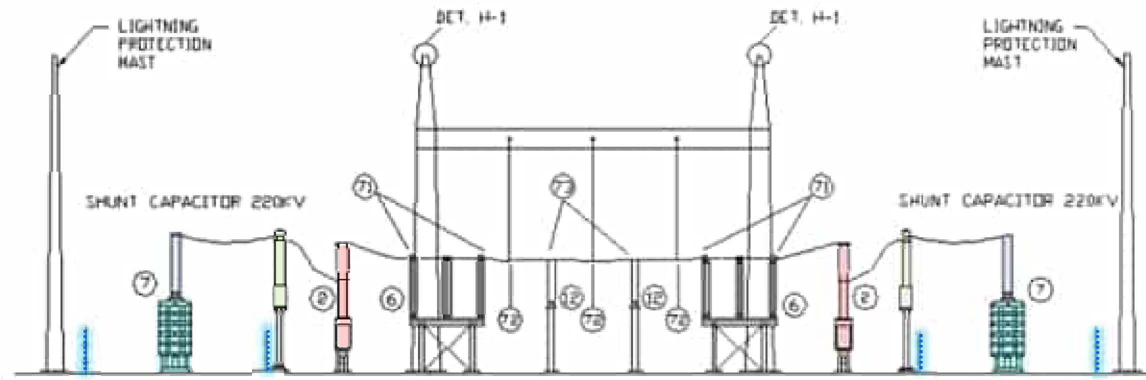
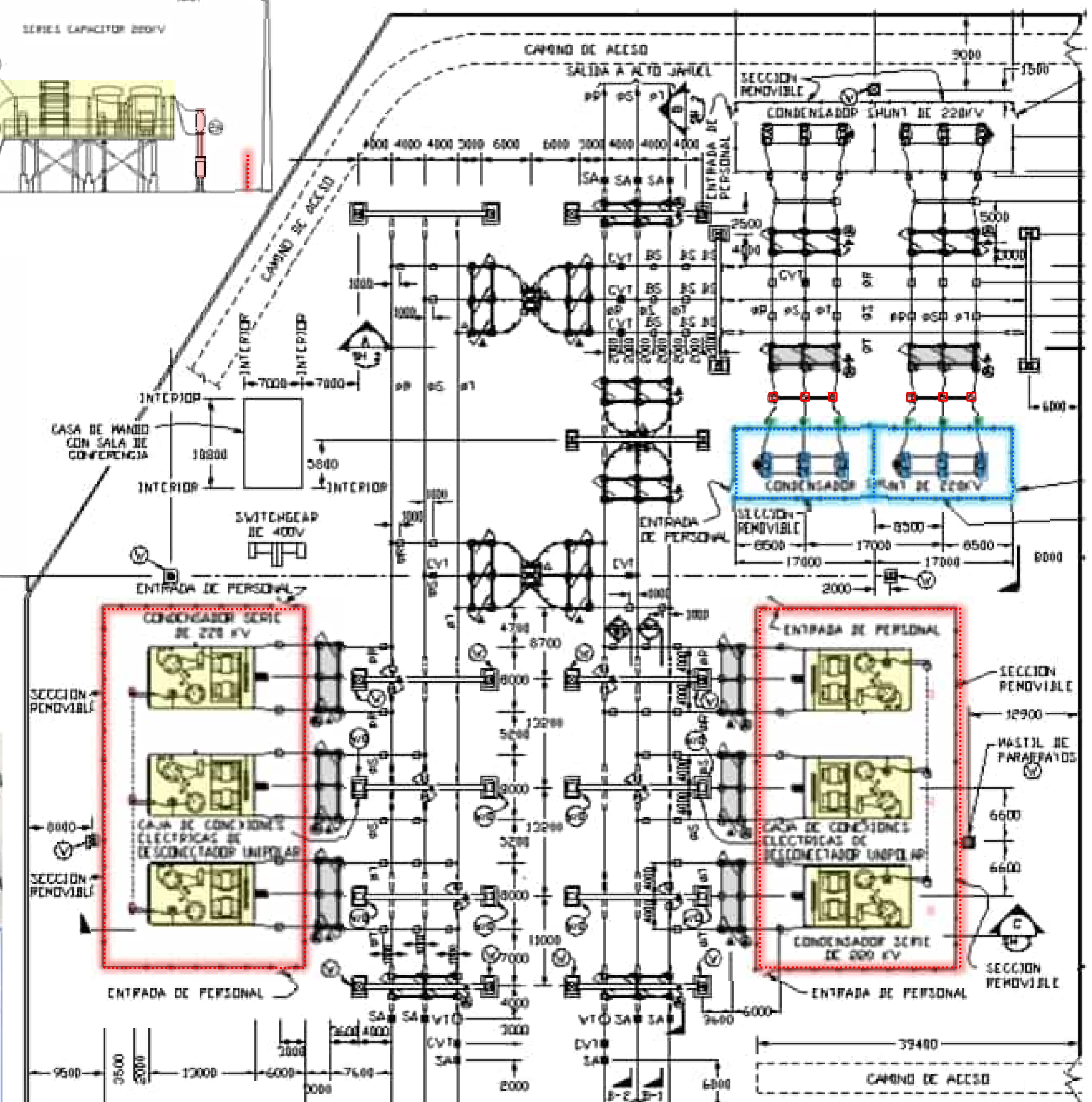
300 km Linea con Compensacion Capacitiva ~US$75M Colbun Chile

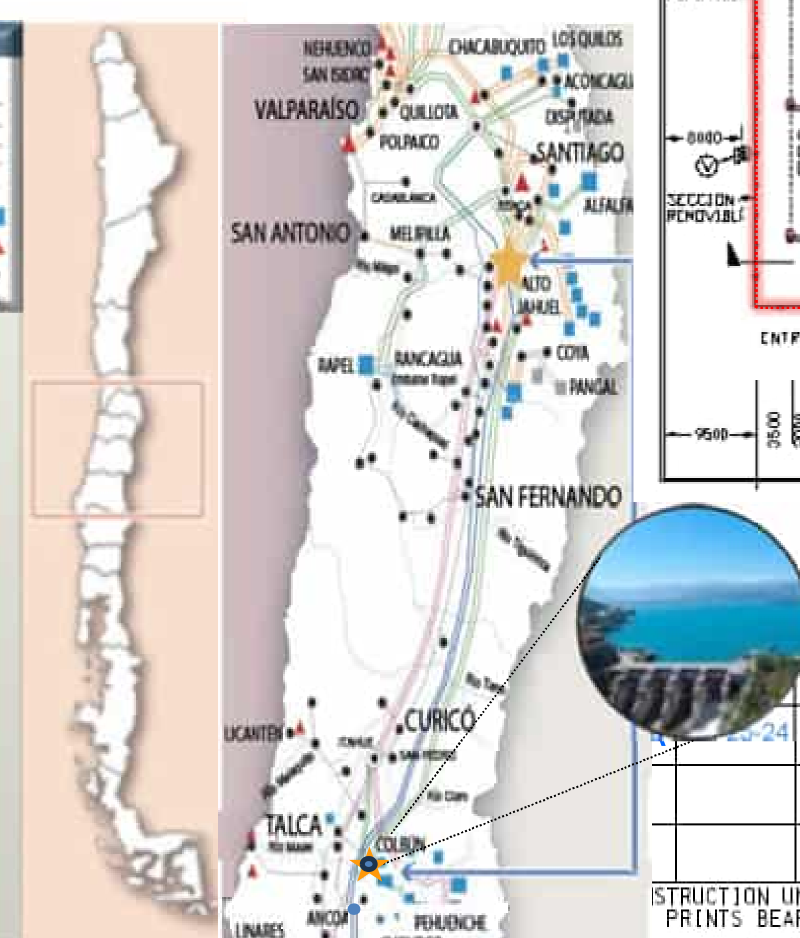


Seccion Condensadores Serie



Seccion Condensadores Shunt





Colbun

	SDE	PEM	Aditado para Presentacion	
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			CHKD:	DATE:
STRUCTION UNLESS SIGNED PRINTS BEARING EARLIER			SCALE: NTS	

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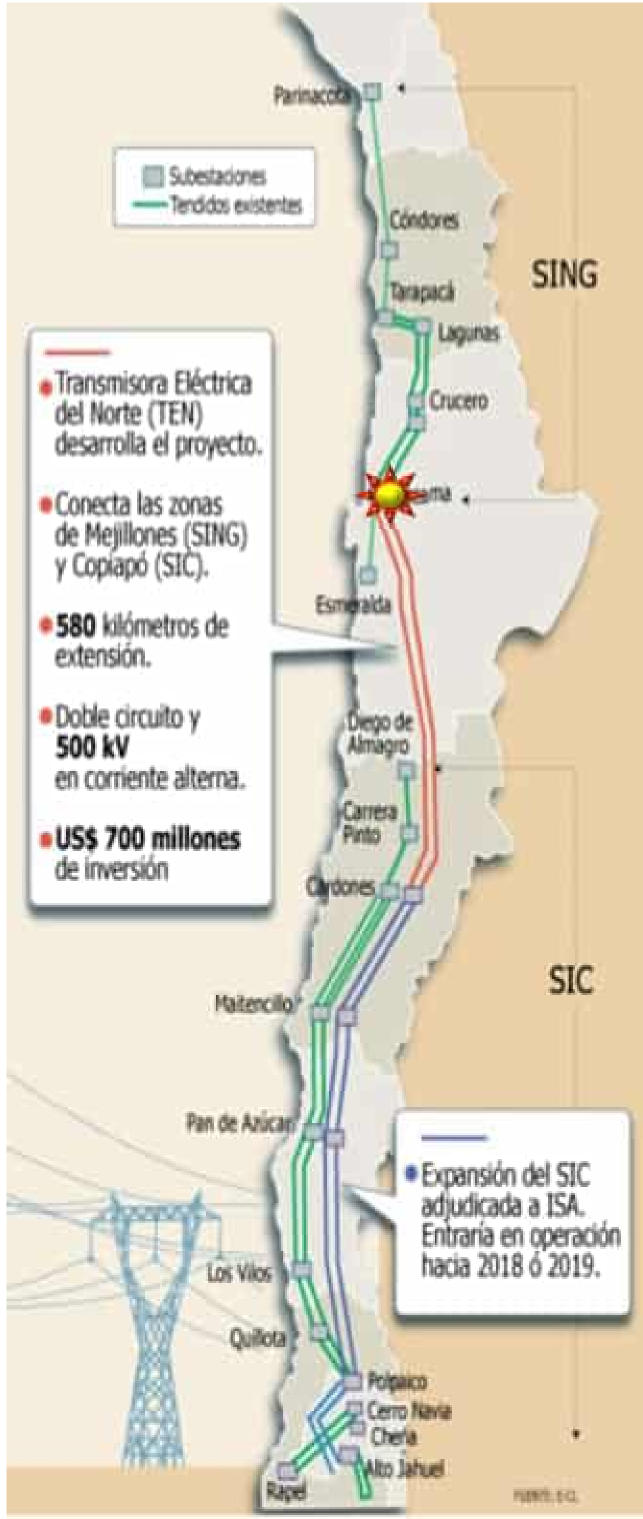
580 km Linea, 2 Plantas & SVC~US$500M - Electroandina Chile



Interconexión SING-SIC en la perspectiva del tiempo.

Texto Junio 2015: Edzard Zapata Helmig, periodista.

"En una conversación sostenida con Elio Cuneo respecto de como expandir el mercado objetivo de la empresa más allá del SING, dado que vislumbrábamos que los niveles de demanda de energía tenían límites, que el nivel de competencia que se esperaba en el futuro en el SING era muy duro y como las oportunidades que existían en la zona norte del SIC se veían atractivas, surge la idea de impulsar un proyecto de transmisión para la interconexión entre los sistemas SING y SIC, que permitiera llegar de manera competitiva al promisorio mercado del norte del SIC".

Elio Cuneo H.

Por esto último, se exponen los conceptos asociados a Jos Remacle, Gerente General de la época, quien da el visto bueno para definir el trazado para el proyecto de transmisión entre Mejillones y Diego de Almagro.

En octubre de 1997, el presidente del Directorio de Electroandina S.A., Yves Jourdain, da a conocer la implementación de un plan estratégico que establecía la interconexión del SING y el SIC en 220 kV y la construcción de unidades a ciclos combinados que consideran gas natural importado de Argentina como insumo principal.

Luis Hormazábal,
Gerente Comercial y Desarrollo de la época.

- El Sistema Interconectado del Norte Grande (SING) se extiende entre Tarapacá y Antofagasta,
- El abastecimiento eléctrico de los distintos centros de consumo se inició con sistemas locales independientes entre sí y destinados exclusivamente a resolver sus necesidades.
- Escasos recursos de agua para usos de generación eléctrica con un clima de extrema sequedad.
- Centros de consumo de electricidad separados por grandes distancias. Consumo de energía corresponde principalmente a empresas mineras.
- A fines de 1987 se interconectaron algunos de estos sistemas, dando origen al Sistema Interconectado del Norte Grande.
- El 30 de julio de 1993 comenzó la operación coordinada de las instalaciones del SING al constituirse el Centro de Despacho Económico. de Carga (CDEC) del SING

ELECTROANDINA

ABB wins US$ 310-million order for Chile power plants

Press release | Zurich, Switzerland | 1998-07-29

Two 400-megawatt power plants for Chile's deregulated electricity market

ABB

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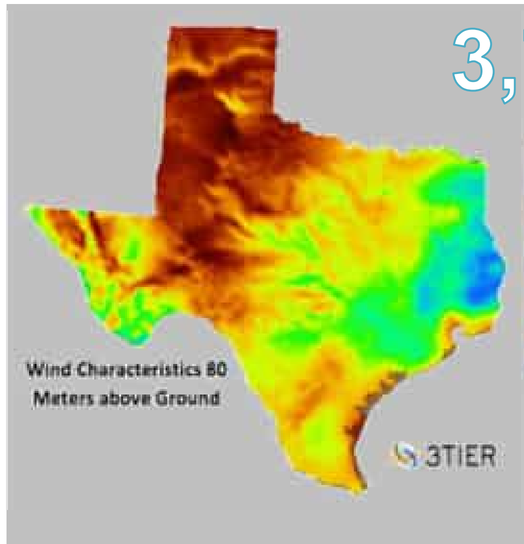
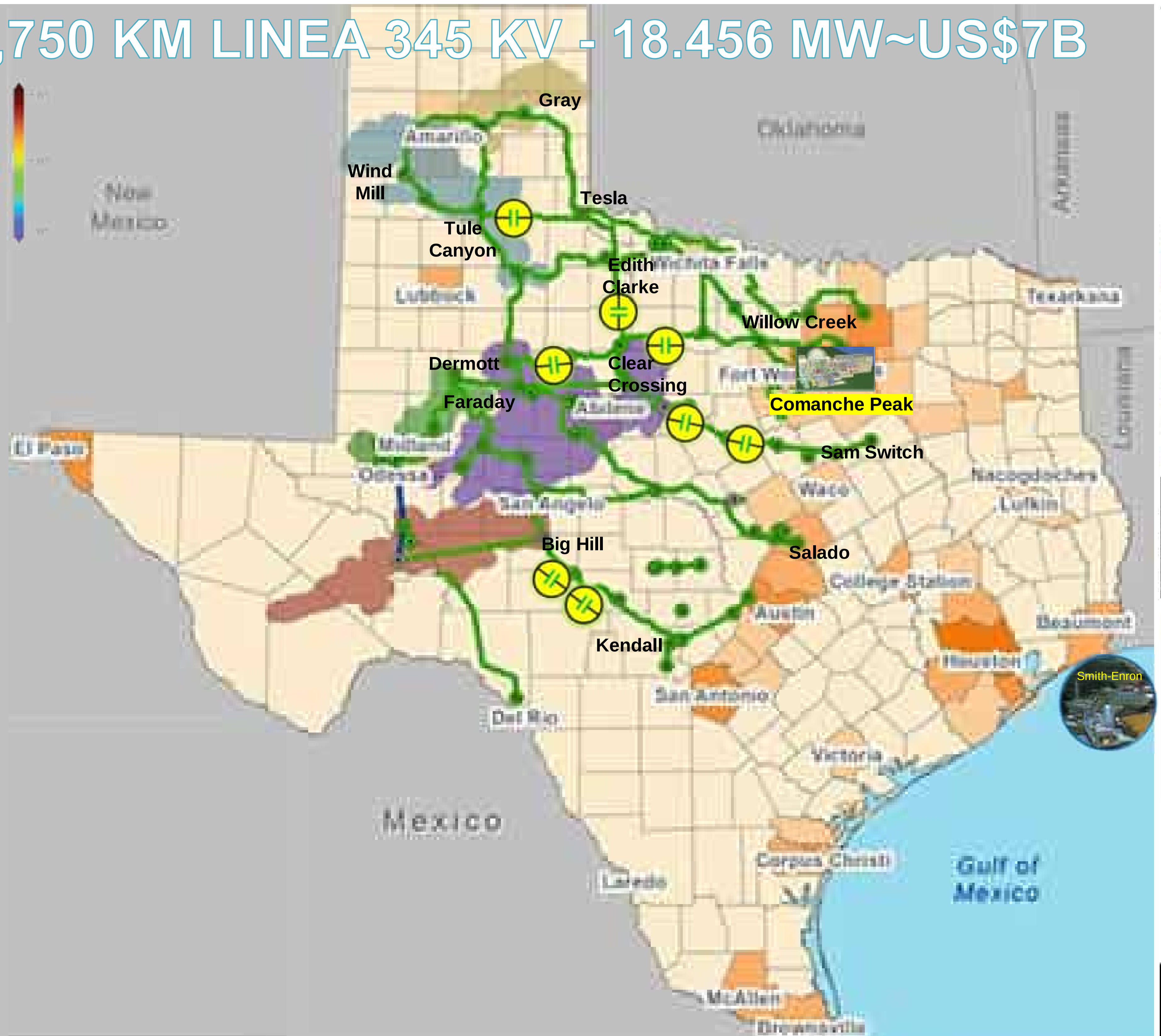
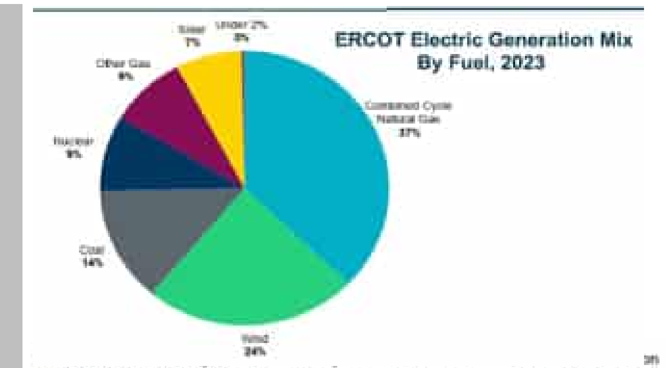
3,750 KM LINEA 345 KV - 18.456 MW~US$7B



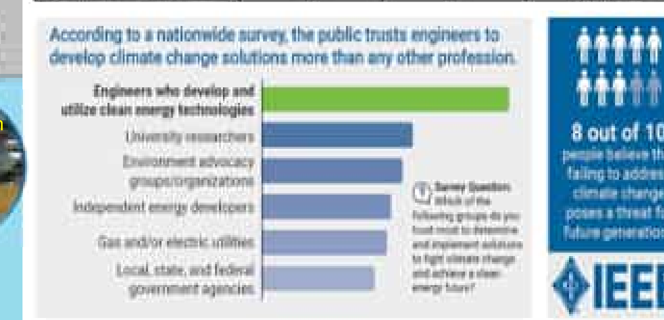




Optimization Study Options

	Option 1 (MW)	Option 2 (MW)	Option 3 (MW)	Option 4 (MW)
Zone 2A	[illegible]	3,191	[illegible]	[illegible]
Zone 4	[illegible]	2,393	[illegible]	[illegible]
Zones 5/6	[illegible]	1,859	[illegible]	[illegible]
Zone 9A	[illegible]	3,047	[illegible]	[illegible]
Zone 19	[illegible]	1,063	[illegible]	[illegible]
CREZ transfer capability	[illegible]	11,553	[illegible]	[illegible]
Total transfer capability	[illegible]	18,456	[illegible]	[illegible]

	TOTAL REQUIREMENT		
	Min Export	Initial Build	Max Export/Edison
Series Capacitor	50% - 12 Lines	50% - 12 Lines	50% - 12 Lines
Shunt Reactors	3930 MVARs	3930 MVARs	3930 MVARs
Shunt Capacitors	0	660 MVARs	1136 MVARs
SVCs or STATCOMs:	0	1400 MVARs	5300 MVARs
Synchronous Condensers	0	0	700 MVA



ETT Project Summary
- 422.5 mi 345 kV lines
- 7 new subs. 345 kV
- 8 HV series capacitors
- 7x2 shunt reactors
- 3 Static Vars Comp.

Electric Transmission Texas

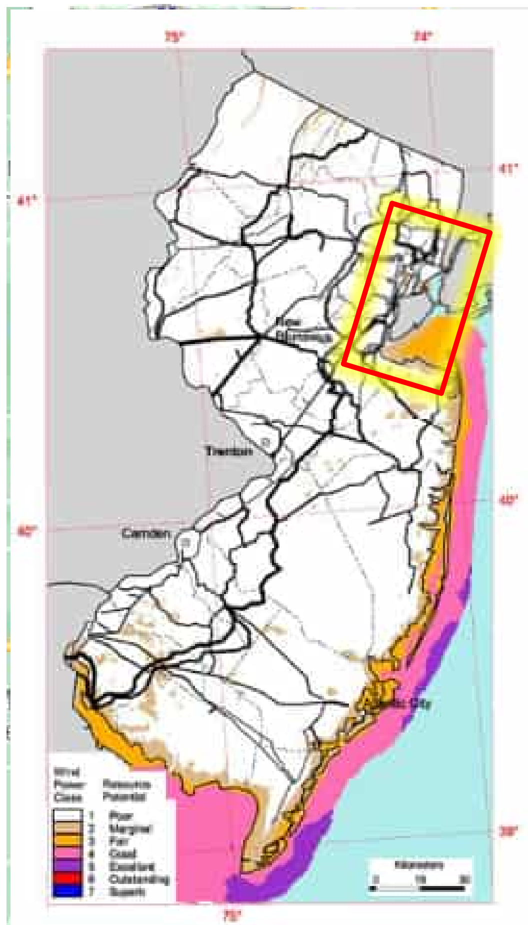
ERCOT

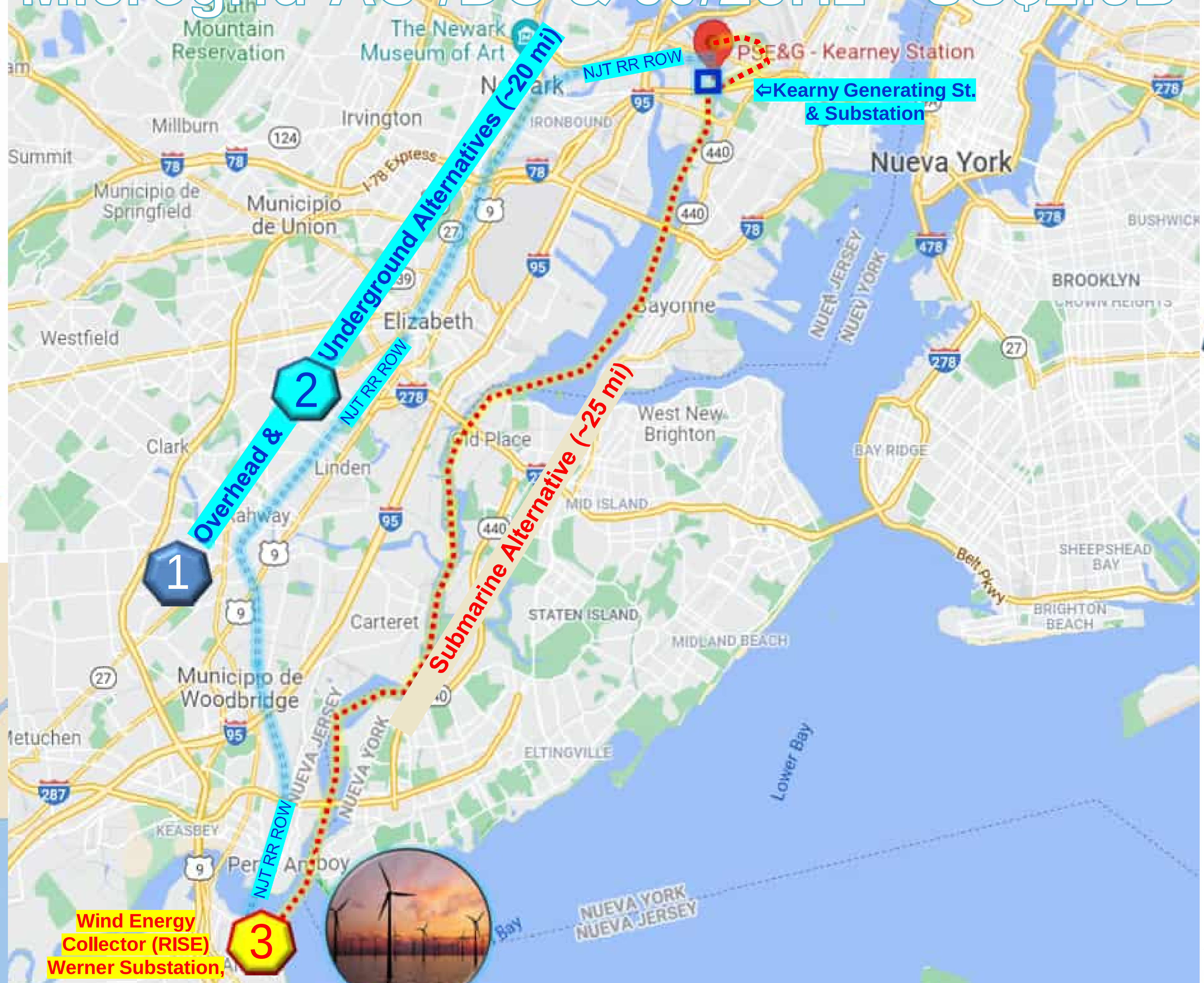
Competitive Renewable Energy Zone (CREZ)

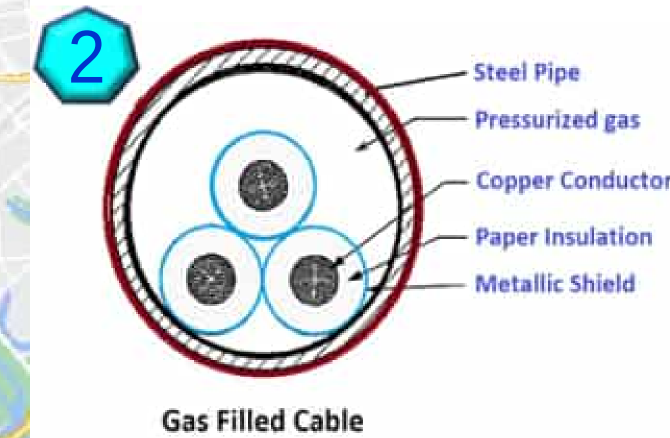
URS

SKT No 12 of 12 | Abril 25, 2024 | REV. A

Microgrid-AC /DC & 60/25Hz ~US$2.5B







Item	Description	Distance Approx (mi)	Cost Referen			Challenger			Remark
			Cost Factor	Cost/mi ($M)	Total Cost ($M)	Permitting	Obstacles	Clearances	
1	Overhead Transmission line in the NJT RR corridor	20	1 (Base)	2.0	40				*Limited ROW, clearance constrain, crosing river and major highway, visible unpleasant. Wetland may require ACOE license and permit (L&P)*
2	Underground line in the NJT RR corridor	20	8	16	320				*Aceptable ROW on NJT RR corridor, crossing other RR tracks, bridges & major infrastructures such as pipeline, gas, sewer & major highway. Water crossing and other obstacle require HDD and Jack & bore. ACOE L&P.*
3	Submarin & UG Raritan Bay and Hackensack River.	25	10	20	500				*Submarine operation require spetial marine contractor (ex Cadwell) and studies. Navigable water require ACOE L&P. Crossing under bridges and existing cables. Work compatible with cable installed by wind developer.*

NJ TRANSIT

TRANSGRID MICROGRID PROJECT-RFP No 20-055

Alternatives for 230 kV Btwn. Werner & Mason Substations

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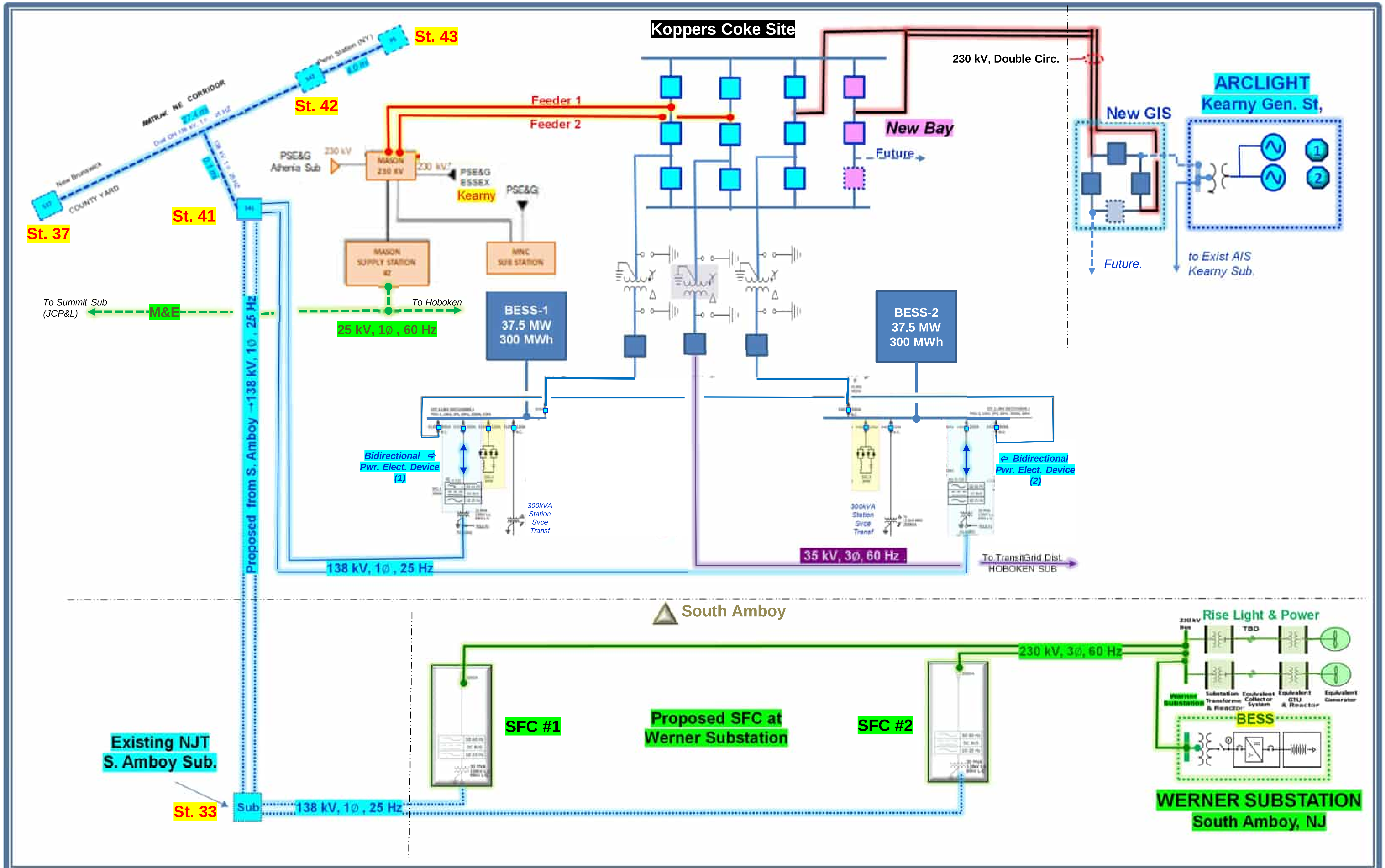
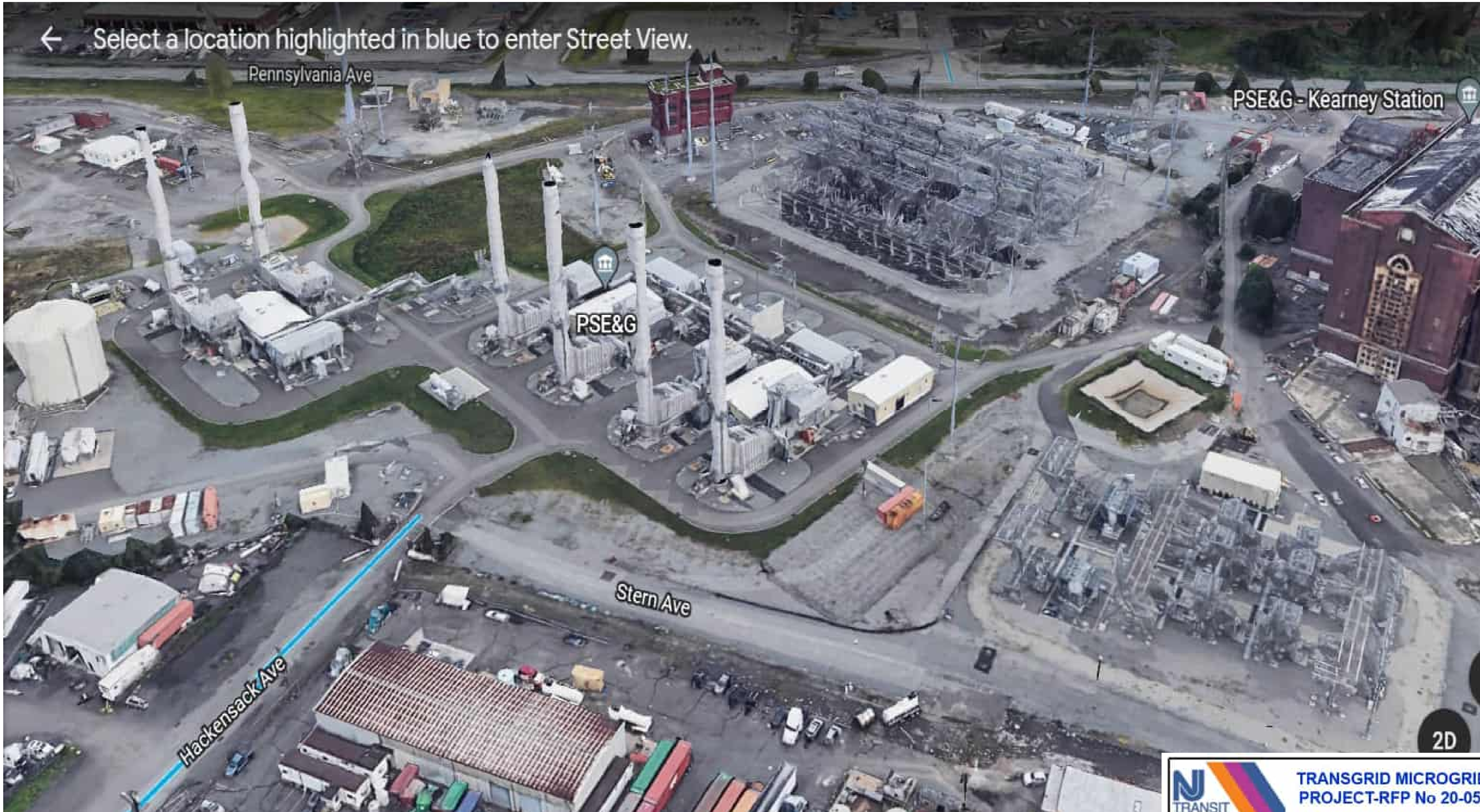
SKT No 13 of 12 | Abril 25, 2024 | REV. A



Koppers Coke Site
St. 43
St. 42
St. 41
St. 37
St. 33
Penn Station (NY)
AMTRAK NE CORRIDOR
New Brunswick
COUNTY YARD
Feeder 1
Feeder 2
PSE&G
Athenia Sub
230 kV
MASON 230 KV
PSE&G
ESSEX
Kearny
PSE&G
MASON SUPPLY STATION
MNC SUB STATION
230 kV, Double Circ.
New Bay
Future
New GIS
ARCLIGHT
Kearny Gen. St,
Future.
to Exist AIS Kearny Sub.
To Summit Sub (JCP&L)
M&E
To Hoboken
25 kV, 1∅ , 60 Hz
BESS-1 37.5 MW 300 MWh
BESS-2 37.5 MW 300 MWh
Proposed from S. Amboy →138 kV, 1∅ , 25 Hz
Bidirectional Pwr. Elect. Device (1)
Bidirectional Pwr. Elect. Device (2)
300kVA Station Svce Transf
138 kV, 1∅ , 25 Hz
35 kV, 3∅, 60 Hz
To TransitGrid Dist. HOBOKEN SUB
South Amboy
Rise Light & Power
230 kV, 3∅, 60 Hz
SFC #1
Proposed SFC at Werner Substation
SFC #2
BESS
Existing NJT S. Amboy Sub.
Sub
138 kV, 1∅ , 25 Hz
WERNER SUBSTATION
South Amboy, NJ



NJ TRANSIT

TRANSGRID MICROGRID PROJECT-RFP No 20-055

REVISION APPROVAL RECORD					
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE
ARCH.			MECHANICAL		
CIVIL			NUCLEAR		
ELECTRICAL			PIPING		
ENVIRON.			PROCESS		
GEN. ARRANG.			QA / QC		
HVAC			STRUCTURAL		
I & C					

REV	DATE	REVISIONS	BY	CHKR

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	A	04-25-24		AP
APPROVED FOR CONSTRUCTION				

NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED & DATED. DESTROY ALL PRINTS BEARING EARLIER DATE &/OR REV.NO.

Aditado para Presentacion

DRN:	DATE:
CHKD:	DATE:
SCALE: NTS	

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SKT No 15 of 12 Abril 25, 2024 REV. A

ALCANCE DE TRABAJO

item	EQUIPMENT DECK	Qty
	GIS Modules:	
	220kV (1 x B105 GIS, local cont, panel &marshalling box)	1
	69 kV (2 x F35 GIS, local cont, panel &marshalling box)	2
1	**Main transformer:**	
	Rating: 280MVA; 230/69/69kV	1
2	*Heat Exchanger (cooler)*	2
4	**Reactor** 60MVAr , 230kV	1
5	**Auxilary transformers:** *(69kV/400V)*	2
11	**P&C Control Room** *(SCADA, Comm. & revenue metering)*	2
13	**AC & DC Auiliary Power :**	
	AC & DC load panels	4
14	*Battery /UPS room*	2
15	*Diesel Gen Package (Noise enclosure, ATS &fuel tank)*	1
	Ancilliaries :	
	Fire protection & suppressionsystem	1
	Heating, Ventilation and Cooling system (HVAC)	1
	Lighting system (illumination & navegation)	1
	Utility receptacle	1
	Lightning protection	1
	Public Address System (PA)	1
	Internal TV system (ITV) / CCTV)	1
	Distribute Temperature Sensing (DTS)	1
	Interface Task:	
	GE Equipment & Design Data	1
	Platform Manufacturer	1
	Submarine Cable (Interconnection & attachment)	1
	Receiving end Utility (Comm., Rev. metering, ISO)	1

Notes:

- Wind farms are assumed to be installed in the sequence N3, N4, N2 and N1.
- Each of the N1 through N4 are assumed to consist of two wind farms each connected to a single ESP rated 250 MW for at total of 500 MW at each N1 through N4.
- A 230 kV AC tie is provided between each of N3 and N4, and between N2 and N1 for cable failure backup (the backup is limited to 500 MW).

Atlantic Wind Connection (AWC)
230kV/69kV Substation
Offshore Platform

REV		REV	DATE	REVISIONS	BY	CHKR
BY	DATE					

DRAWING STATUS	REV	DATE	SDE	PEM
ISSUED				
PRELIMINARY	A	04-25-24		AP
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CHKD: DATE:

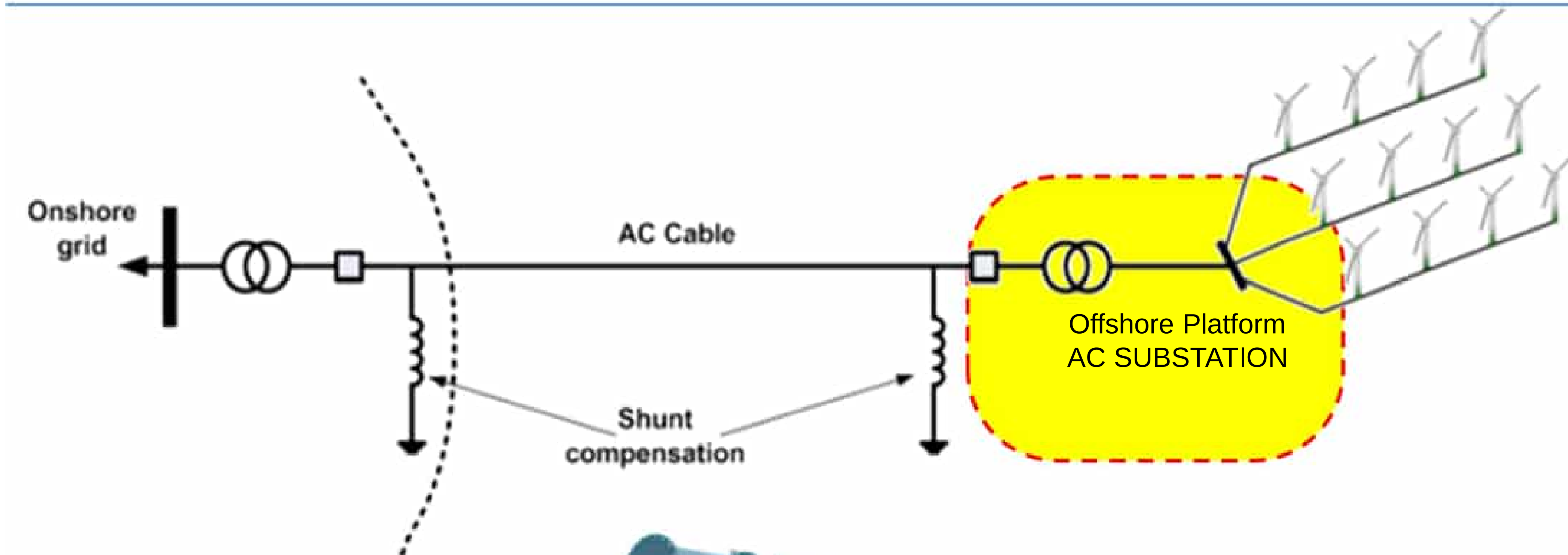
SCALE: NTS

General Arrangement
Wind Farm & Offshore Sub

AECOM
6200 South Quebec Street Greenwood Village, CO 80111

SKT No 16 of 12 Abril 25, 2024 REV. A

Long distance submarine cables have high losses and can generate significant VARs necessitating reactors to control power factor.

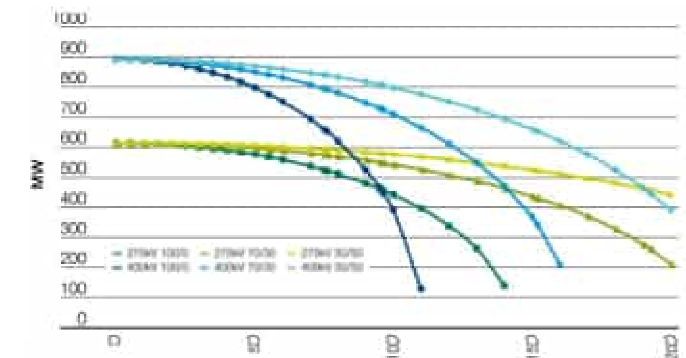


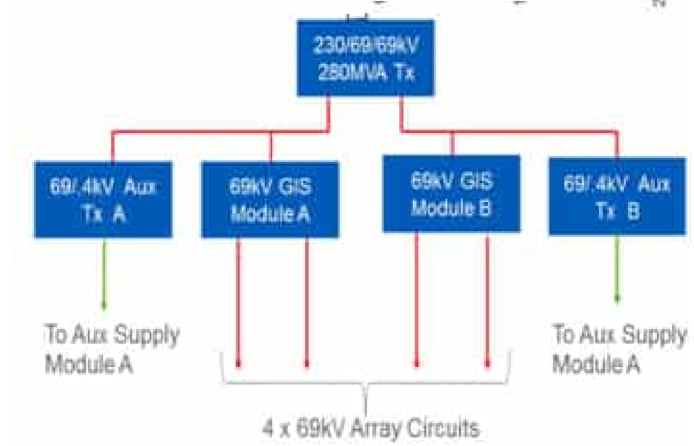
Reactor

Transformer

Transmission Voltage (kV)	Critical Distance (km)
132	370
220	281
400	202

Critical distance is achieved when half of the reactive current produced by the cable is equal to nominal current





Atlantic Wind Connection (AWC)
230kV/69kV Substation
Offshore Platform

REVISION APPROVAL RECORD				REV	
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE
ARCH.			MECHANICAL		
CIVIL			NUCLEAR		
ELECTRICAL			PIPING		
ENVIRON.			PROCESS		
GEN. ARRANG.			QA / QC		
HVAC			STRUCTURAL		
I & C					

REV	DATE	REVISIONS	BY	CHKR

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	A	04-25-24		AP
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Aditado para Presentacion

DRN:	DATE:
CHKD:	DATE:

SCALE: NTS

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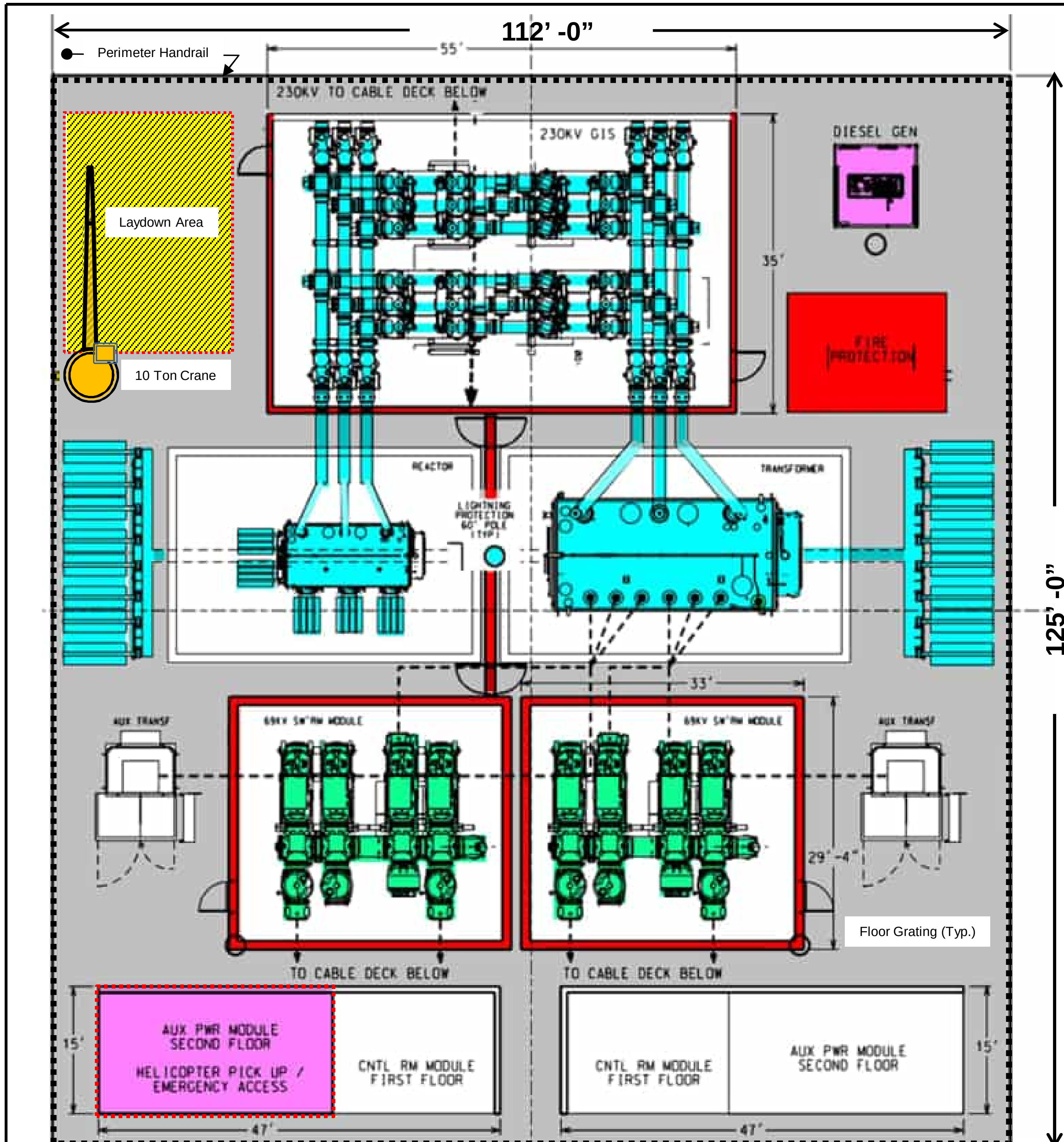

Mayor Equipment Weight & Dimensions

Item	Equipment Description	width		length		height		Weight
		ft.	In	ft.	In	ft.	In	US tons
1	230/69/69kV 280MVAMain transformer - tank	15	3	26	11	31	2	275.8
2	230/69/69kV 280MVAMain transformer - cooler	10	4	26	1	16	5	40.7
3	230/69/69kV 280MVAMain transformer - cooler	10	4	26	1	16	5	40.7
4	230kV 60MVAr reactor	15	9	36	1	20	4	98.2
5	Auxilary transformer A	3	11	7	3	7	3	4.1
6	Auxilary transformer B	3	11	7	3	7	3	4.1
7	"Sergi" fire suppression system skid	9	10	16	5	13	1	22.0
8	230 kV GIS Module	35	0	55	0	18	10	37.3
9	69 kV Switchroom Module A	33	0	29	4	18	10	33.1
10	69 kV Switchroom Module B	33	0	29	4	18	10	33.1
11	Control Room Module A	11	10	32	2	12	6	36.0
12	Control Room Module B	11	10	32	2	12	6	38.7
13	Auiliary Power Module A	11	10	19	0	12	6	33.1
14	Auiliary Power Module B	11	10	19	0	12	6	33.1
15	Diesel Generator Module	9	10	9	10	24	7	44.1
16	Service Crane (Boom 20-50 ft.)	25	0	5	0	15	0	5.0
17	Dump Tank (Accommodate 85 ton transf Oil)	10	0	10	0	40	0	15.0
	Contingency @ 10%							88.3
	Total							**883**

GRAPHICAL SCALE

0 10 20 30 40

SCALE IN FEET

Atlantic Wind Connection (AWC)
230kV/69kV Substation Offshore Platform

Equipment Deck BOM & Platform General Arrangement

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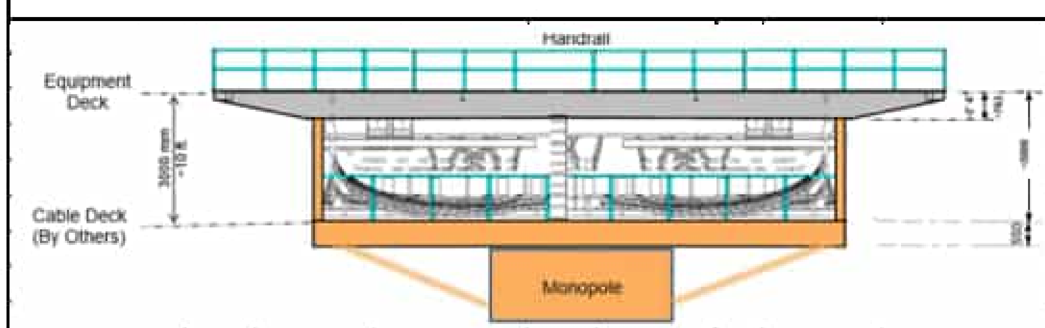

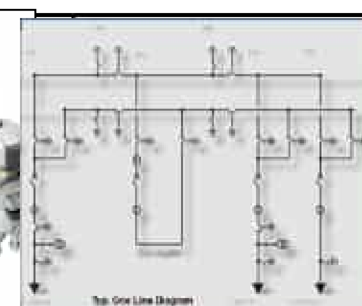

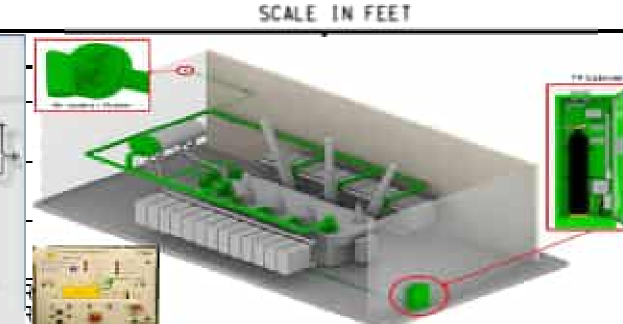

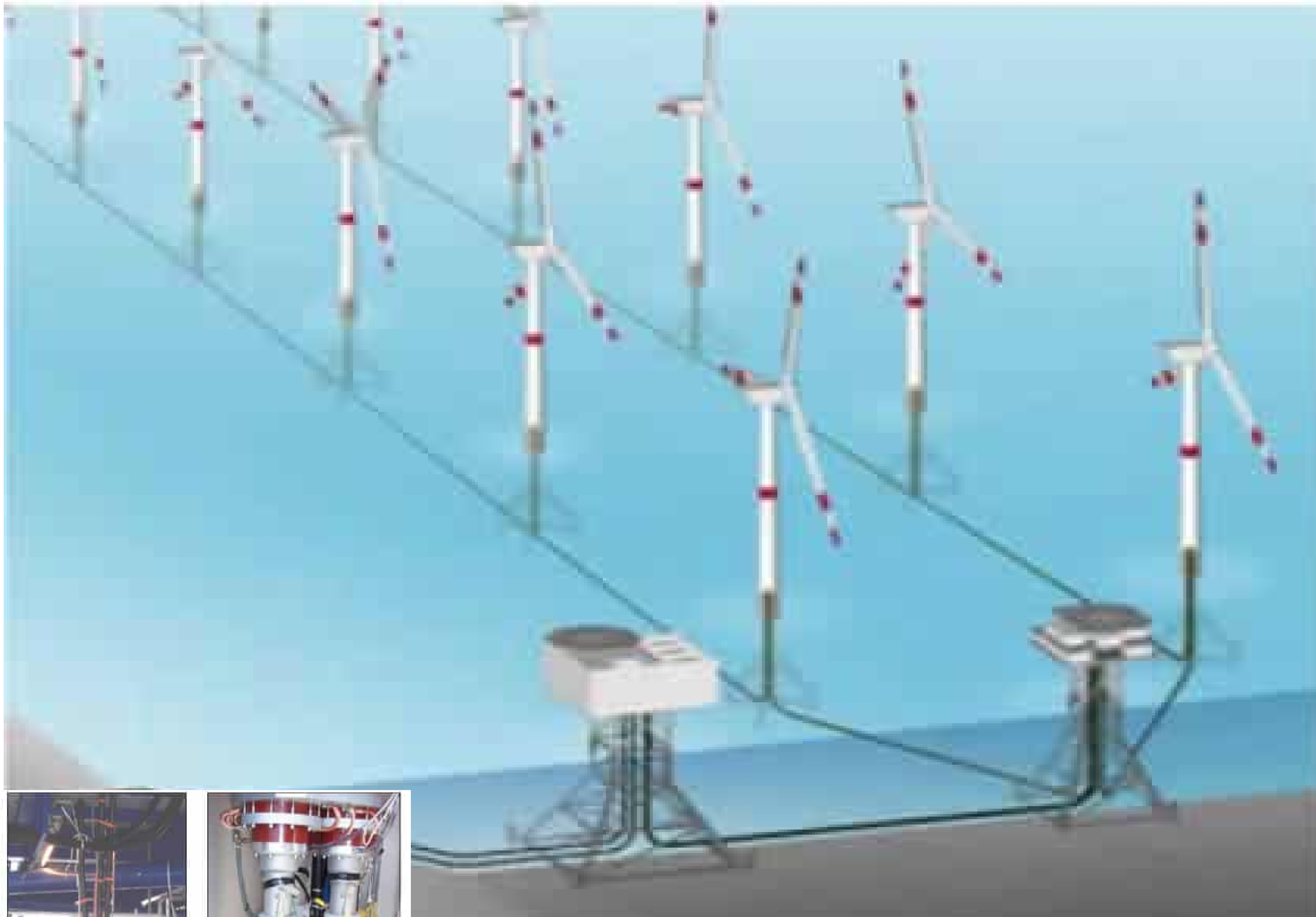

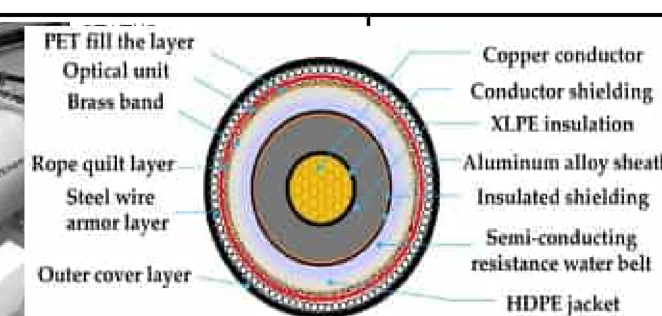

Atlantic Wind Connection (AWC)
230kV/69kV Substation
Offshore Platform

Offshore AC Substation & Wind Generators

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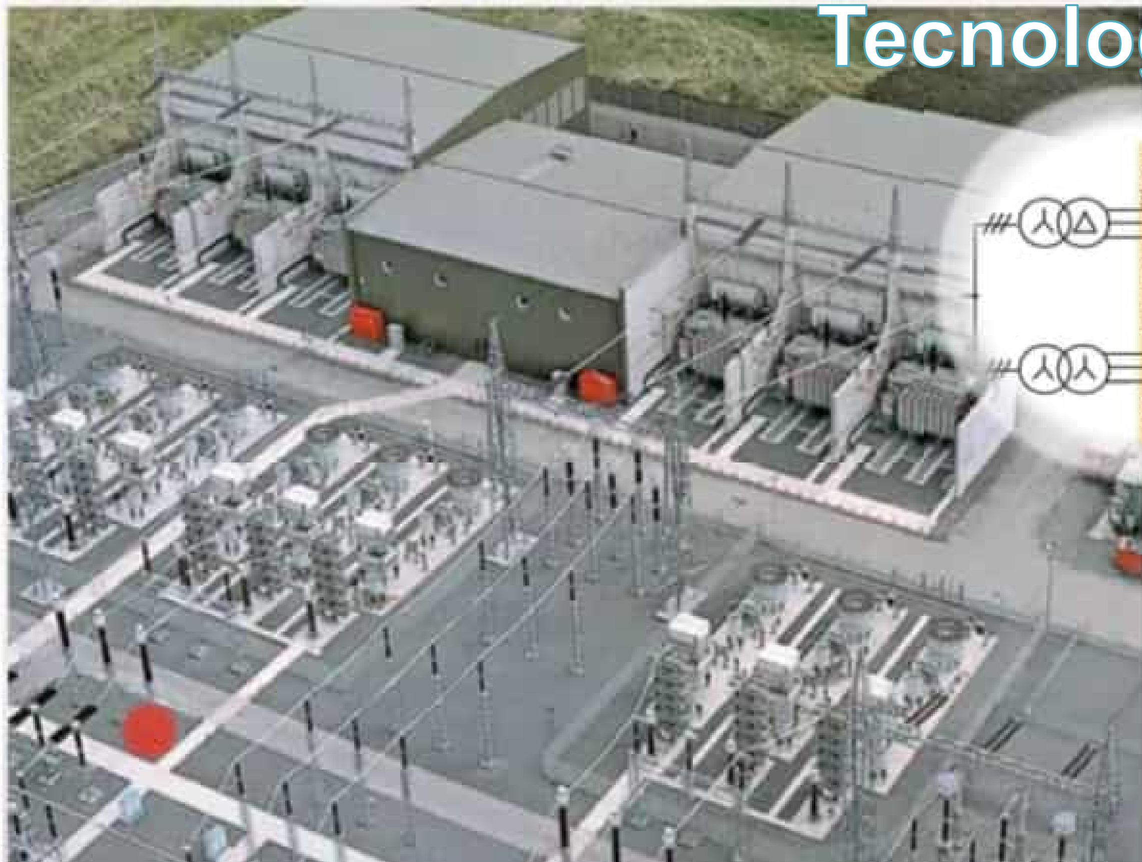
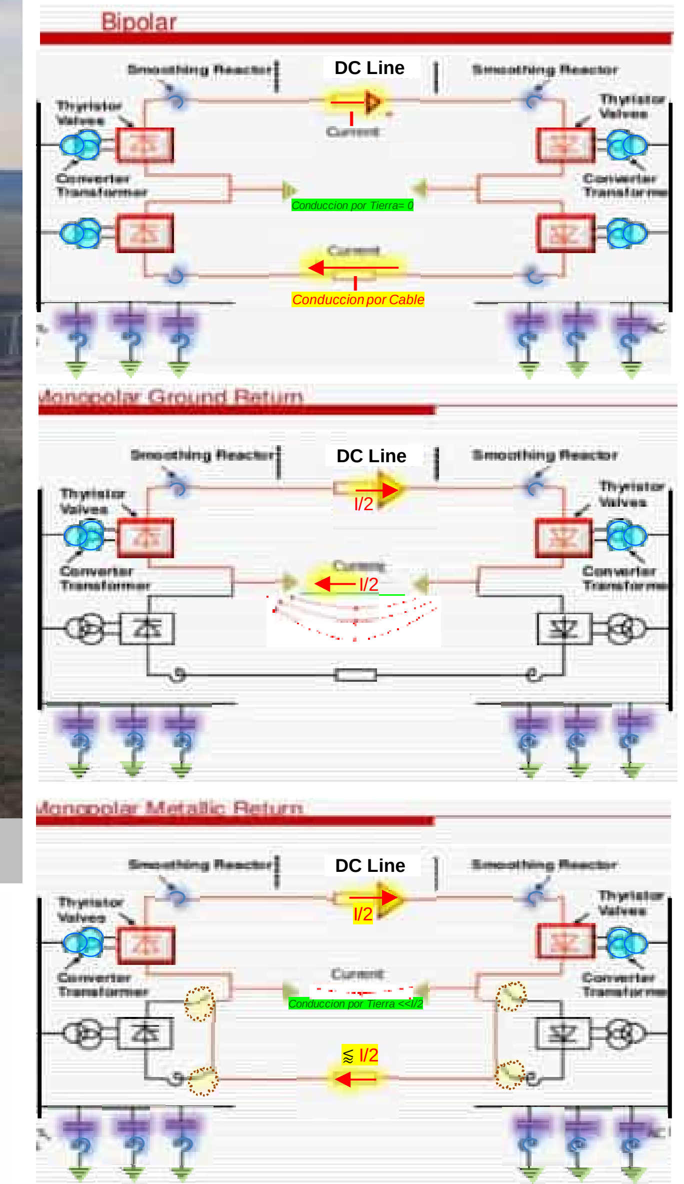
Tecnologias HVDC



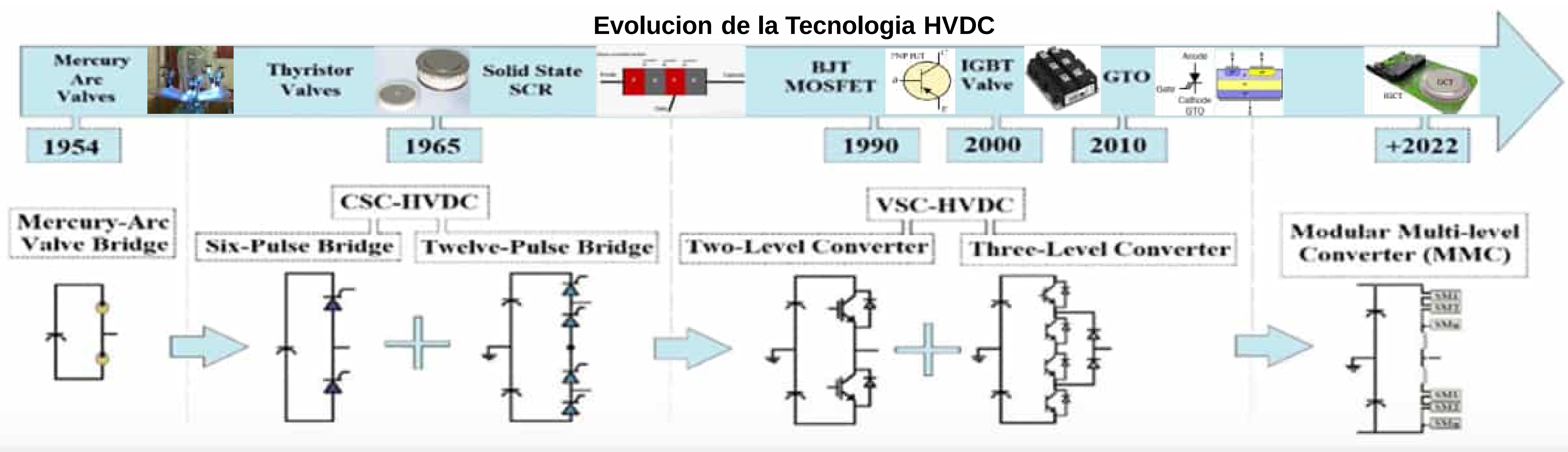
HVDC Clasico –*LCC- Tiristores – 4,000 a 8,000 MW & ≤1,100kV*

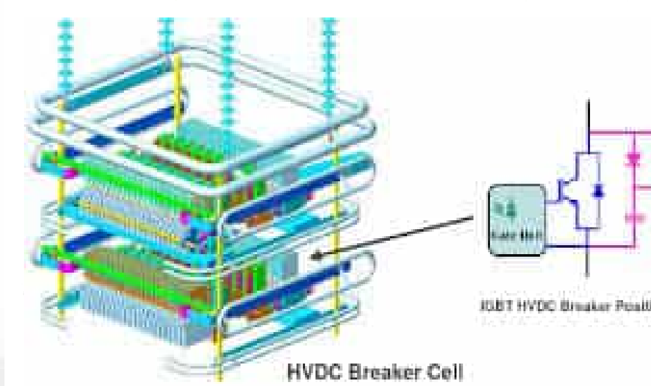
HVDC VSC – *Gate Bipolar Transistors 500 - 3,000 MW & ≤ ±535kV*

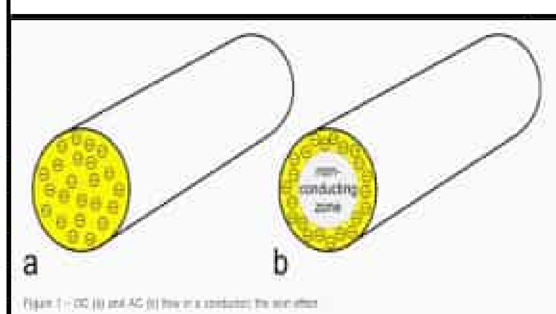
CONFIGURACIONES HVDC

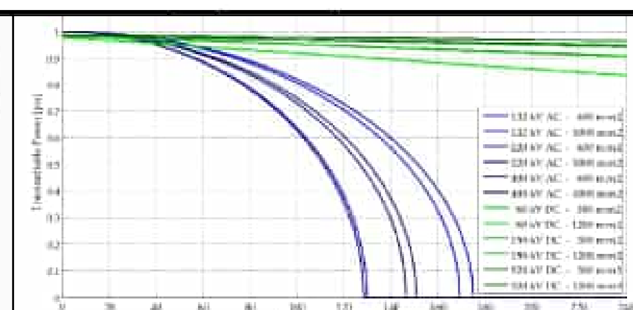


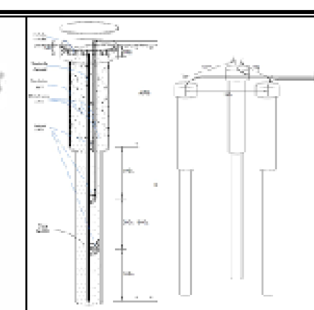
Evolucion de la Tecnologia HVDC

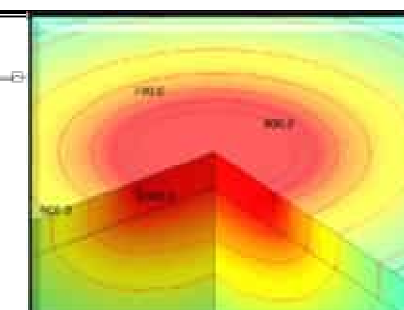






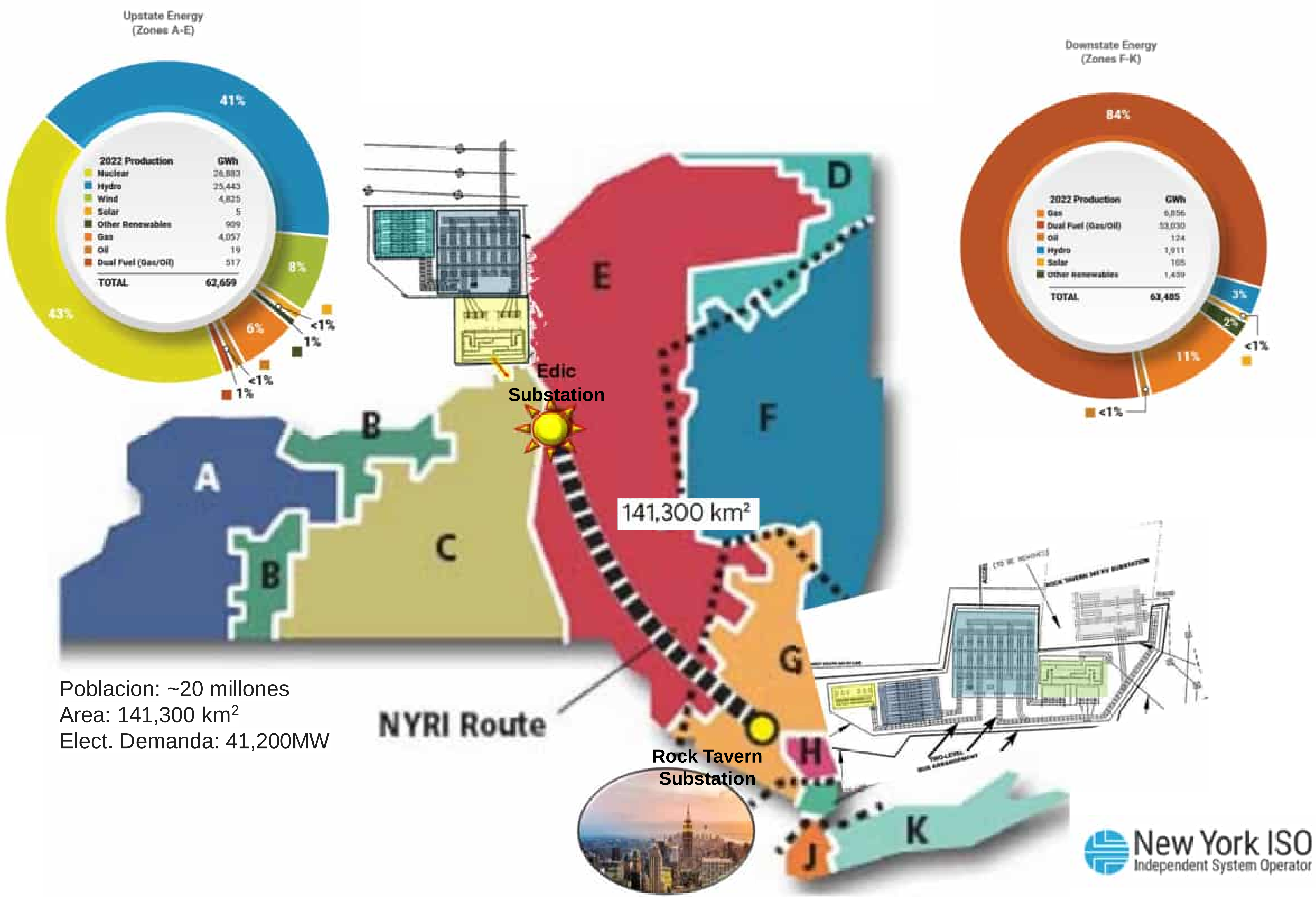






Comparacion con los Tipos De Tegnologia de HVDC

HVDC LCC - NY Regional Interconnection (NYRI), 1200MW, 300 km de Lineas @ ±400 kV



Poblacion: ~20 millones
Area: 141,300 km^2
Elect. Demanda: 41,200MW

DESCRIPCION GENERAL

- **Capacidad HVDC:** 1200MW, ±400kV dc, estaciones convertidoras bipolares interconectando dos empresas electricas, National Grid y Central Hudson Gas & Elect.
- **Typo de linea**: Hibrido con cable soterrado y aereo de 190 millas (305 kms).
- **Costos:** US$2.1 Billion (2011)
- **Localizacion:** Norte del Estado de NY (Oneida Cty) donde hay abundante energia al suroested proximo a la ciudad de NY con alta demanda y buenos precios.
- **Proposito:** Aliviar las limitaciones del corredor de transmision *approvechando la controlabilidad del flujo de potencia en HVDC para circunvalancear el congestionado corridor AC*
- **Tarifa Electrica:** *Reduccion costo de los consumidores 6%, incrementar margen de ganancias de los generadores y aumentar los ingresos asociados con la congestion.*

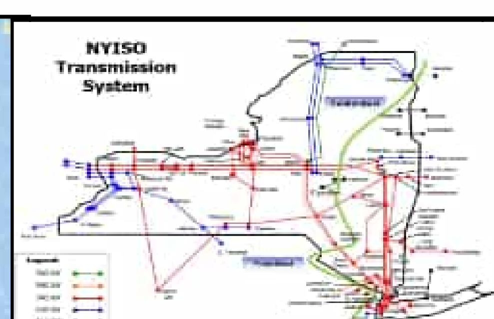
NYISO – Beneficios Economicos - HVDC

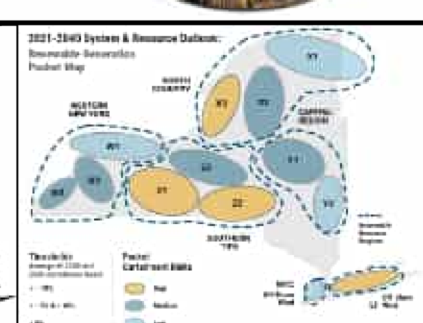
NYISO Annual (M$)	Base Case No HVDC	With HVDC	Benefit (M$)
Consumer Payment	9300.53	9290.81	9.72
Producer Net Profit	2573.81	2601.25	27.45
Congestion Cost	148.20	137.31	-10.89
Total NYISO Benefit			26.28

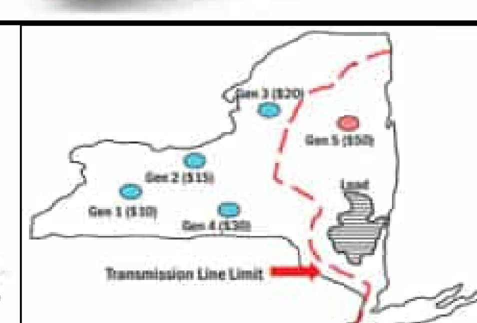
NYISO – Beneficios Economicos - HVAC

NYISO Annual (M$)	Base Case No HVDC	With AC	Benefit (M$)
Consumer Payment	9300.53	9298.99	1.54
Producer Net Profit	2573.81	2588.67	14.86
Congestion Cost	148.20	141.97	-6.22
Total NYISO Benefit			10.18

LBMP = Energy + Loss - Congestion



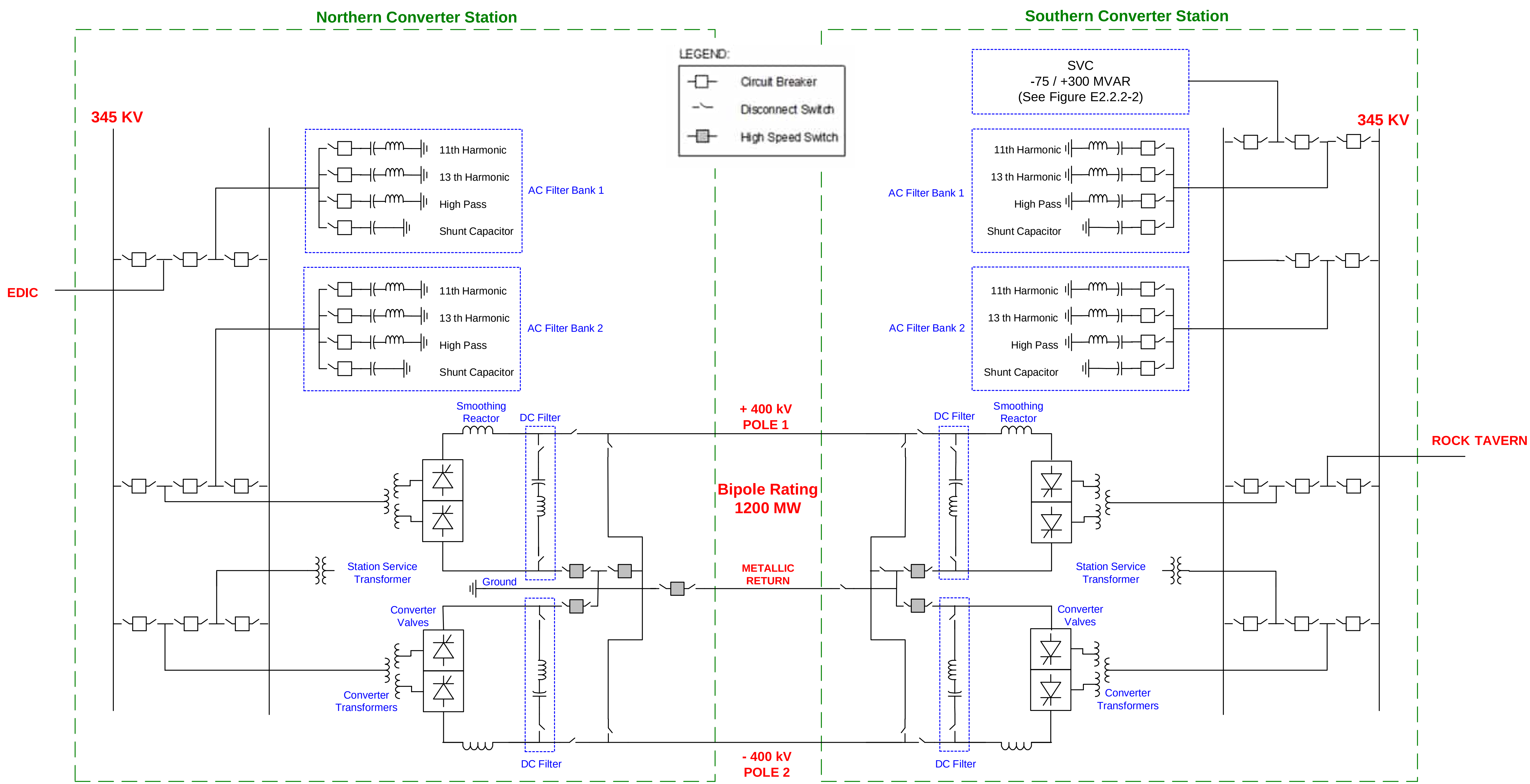




NEW YORK REGIONAL NYRI INTERCONNECTION

Datos Generales & Beneficios del Proyecto

URS



New York Regional Interconnection
DC System
Single Line Diagram

Figure E2.1 | Rev. 0

Beacon Wind HVDC- NY ~US$2.5B

Characteristic	Rating
Rated Power	1,300 MW
Rated Voltage	± 320 kV
Rated Current	2,031 A
Insulation	XLPE
Insulation temperature	
Continuous operating	70°C
Emergency operation	N/A
Water Depth (m)	35 to 65
Average Sea water temp (°C) at 30 m water depth	16
Cable burial depth offshore (m)	1.82 m (6 ft)
Cable Installation method	Cable buried in tren
Seabed Soil resistivity (K.m/ W)	0.7
Min Max ambient temp (Cable in J-tube)	27 / -19
Solar Radiation on J tube (W / m2)	500
Landfall Installation In HDD,	max depth up to 25 m
Landfall resistivity (K.m/ W)	0.9
Ground temperature at HDD Dependent on chosen HDD profile.	To be evaluated.
Onshore cable burial depth (m)	1.5
Ground temp at 1.5 m burial depth (°C)	20
Onshore soil Thermal resistivity (K.m/ W)	1.2
Offshore Ambient Air temp (°C) Max/ Min	27 / -19

equinor

Project EQUINOR CABLE ROUTING PROJECT

NYPA 3D RENDERING 1
Base Design 4-1ϕ Transf & **AIS Bkrs**

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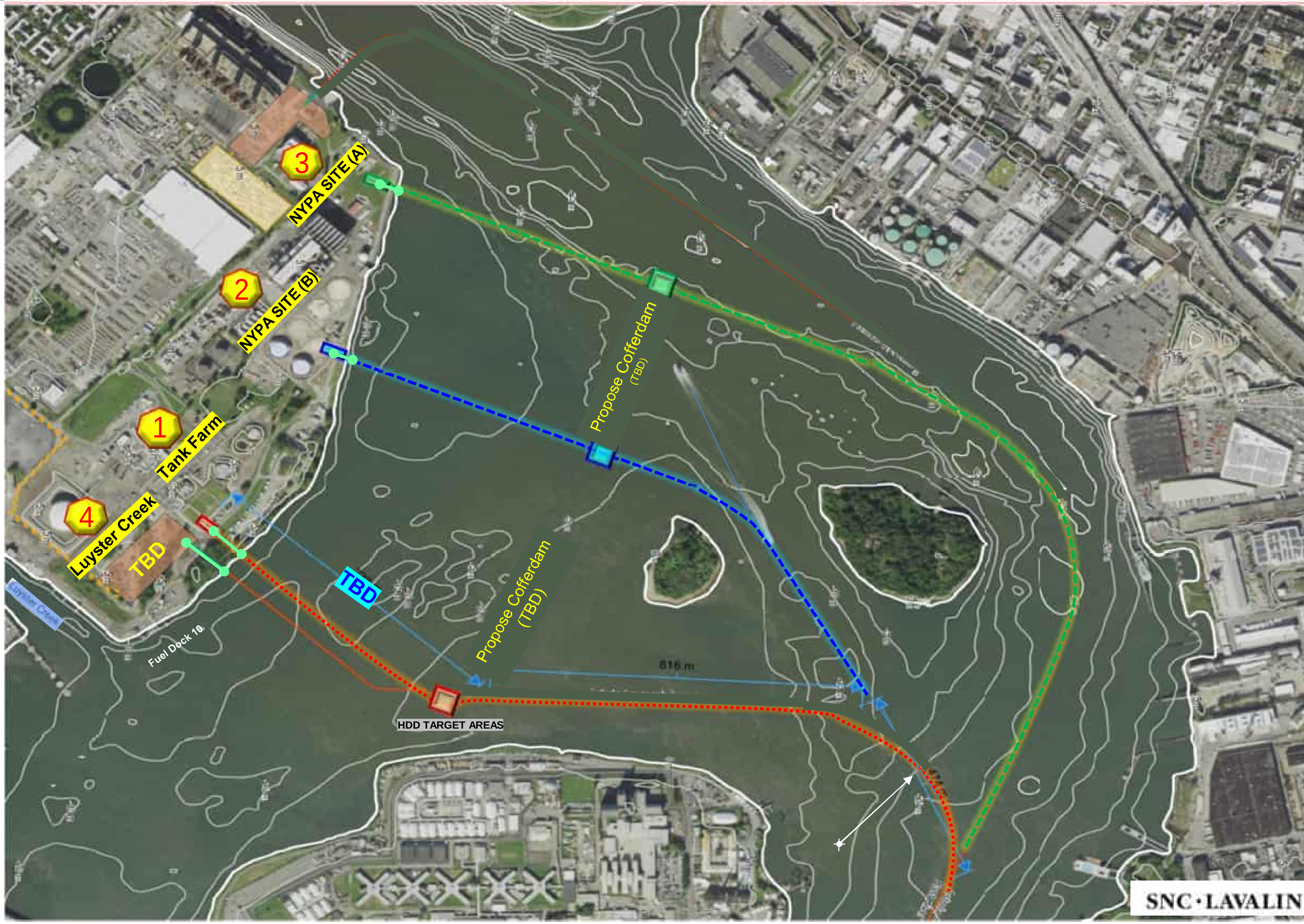
Engineers & Constructors

SKT No 23 of 12 Abril 25, 2024 | REV. A



REVISION APPROVAL RECORD			REV		
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE
ARCH.			MECHANICAL		
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I & C					

REV	DATE	REVISIONS	BY	CHKR

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Aditado para Presentacion

DRN:	DATE:
CHKD:	DATE:

SCALE: NTS

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Project

EQUINOR CABLE ROUTING PROJECT

Conceptual

Submarine Cable

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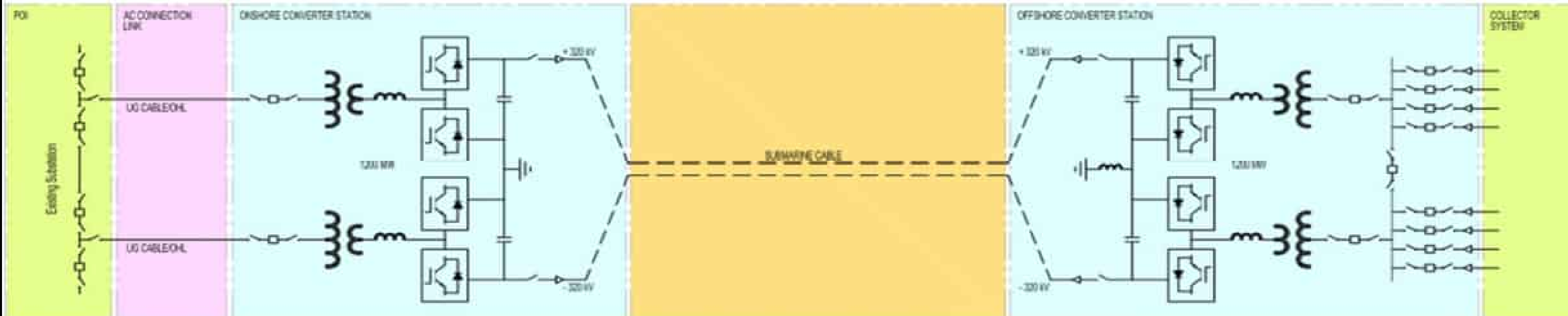
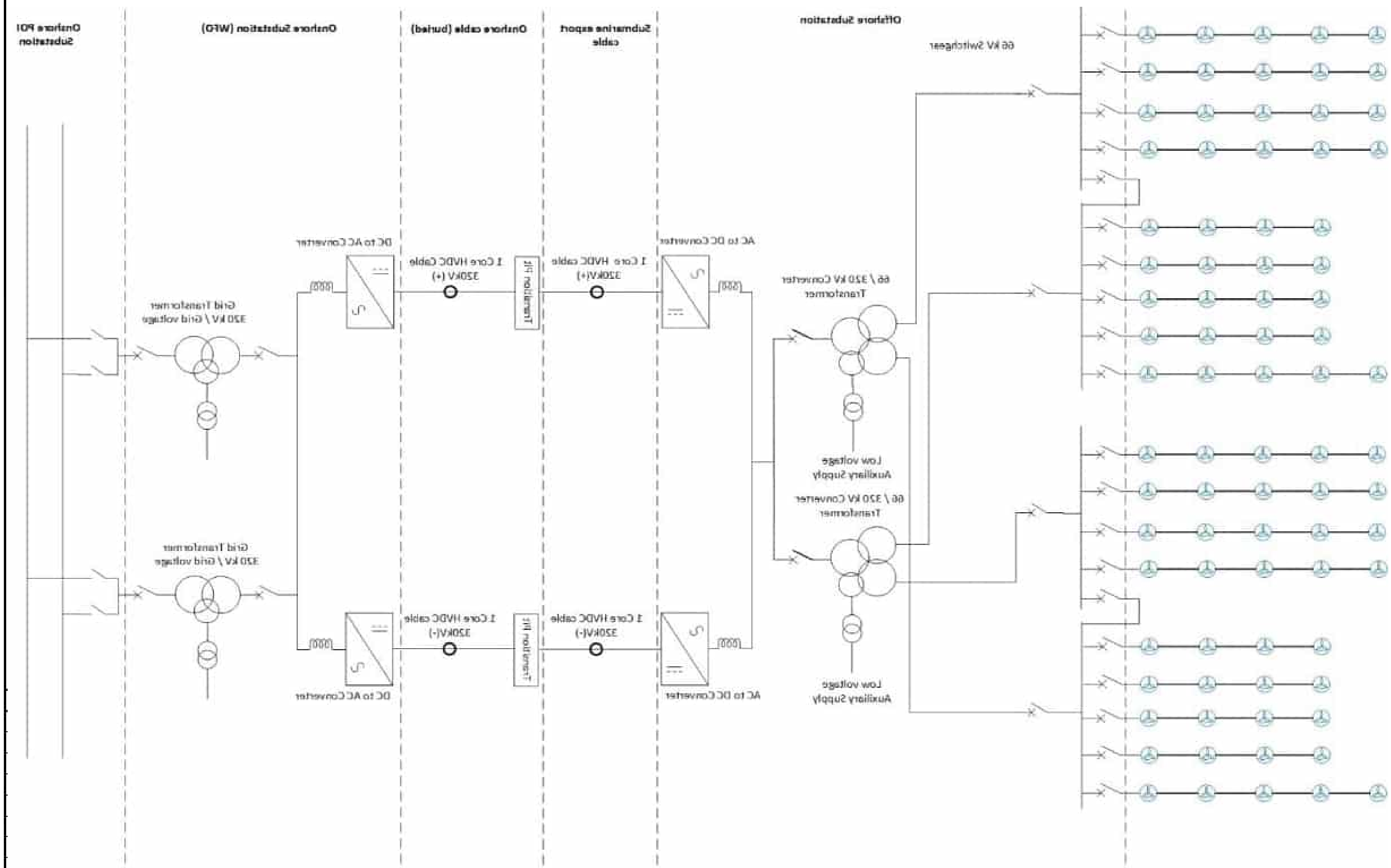
SKT No 24 of 12 Abril 25, 2024 REV. A





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Project

EQUINOR CABLE ROUTING PROJECT

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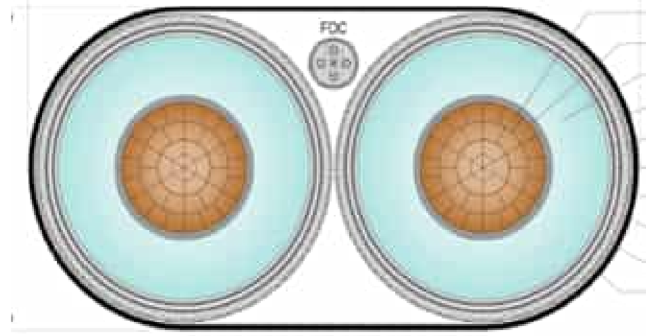
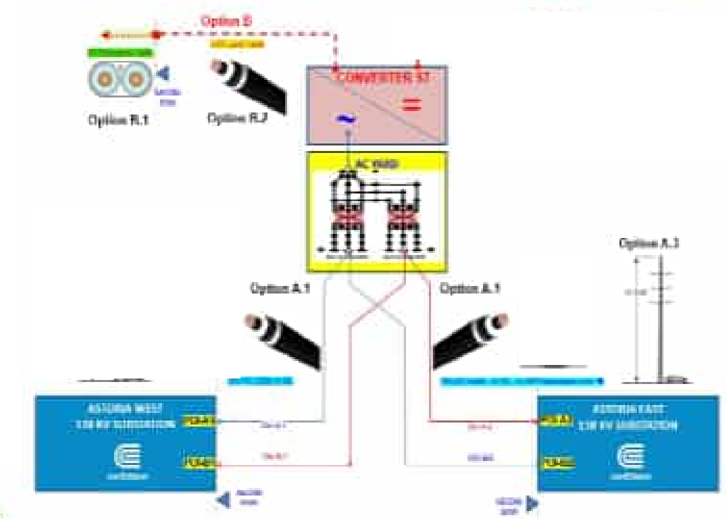
Engineers & Constructors

SKT No 25 of 12 | Abril 25, 2024 | REV. A

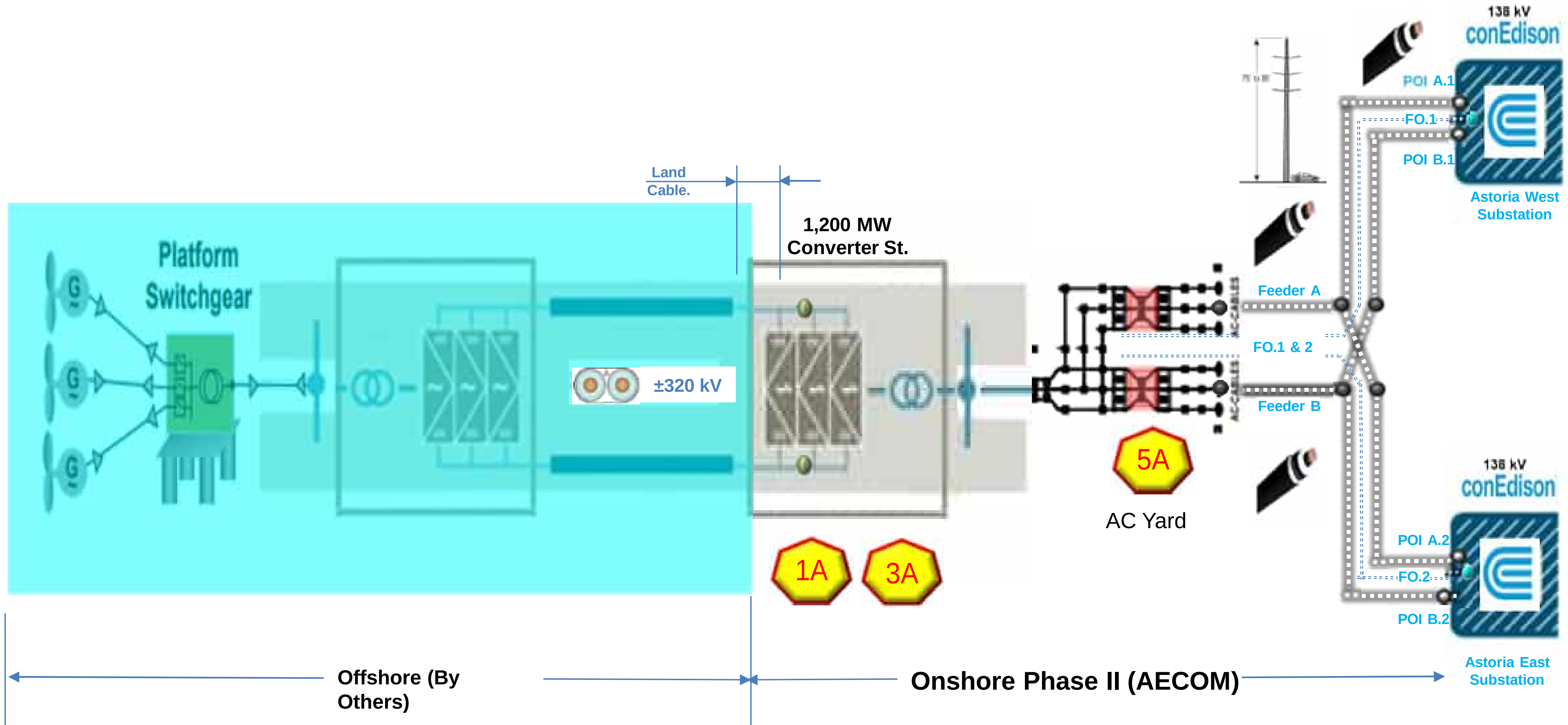


3. Extend Submarine Cable

DC & AC INTERCONNECTING HV LINES



NOTE: *POI locations & circ Bkrs. TBD*



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CIVIL			NUCLEAR							
ELECTRICAL			PIPING							
ENVIRON.			PROCESS							
GEN. ARRANG.			QA / QC							
HVAC			STRUCTURAL							
I & C										

DRAWING STATUS				
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PRELIMINARY	A	04-25-24		AP
APPROVED FOR CONSTRUCTION				
NOT APPROVED FOR CONSTRUCTION UNLESS SIGNED & DATED. DESTROY ALL PRINTS BEARING EARLIER DATE &/OR REV.NO.				

Aditado para Presentacion

DRN:	DATE:
CHKD:	DATE:
SCALE: NTS	

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Project: EQUINOR CABLE ROUTING PROJECT

SIMMETRICAL MONOPOLE SYSTEM ONE LINE DIAGRAM

UNITED Engineers & Constructors

SKT No 26 of 12 Abril 25, 2024 REV. A

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EQUINOR CABLE ROUTING PROJECT

CABLE LEGTH TO THE POI TANK FARM TO SUBSTATIONS

UNITED Engineers & Constructors

REVISION APPROVAL RECORD					
DISCIPLINE	BY	DATE	DISCIPLINE	BY	DATE
ARCH.			MECHANICAL		
CIVIL			NUCLEAR		
ELECTRICAL			PIPING		
ENVIRON.			PROCESS		
GEN. ARRANG.			QA / QC		
HVAC			STRUCTURAL		
I & C					

REV	DATE	REVISIONS	BY	CHKR

DRAWING STATUS				
ISSUED	REV	DATE	SDE	PEM
PRELIMINARY	A	04-25-24		AP
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Aditado para Presentacion

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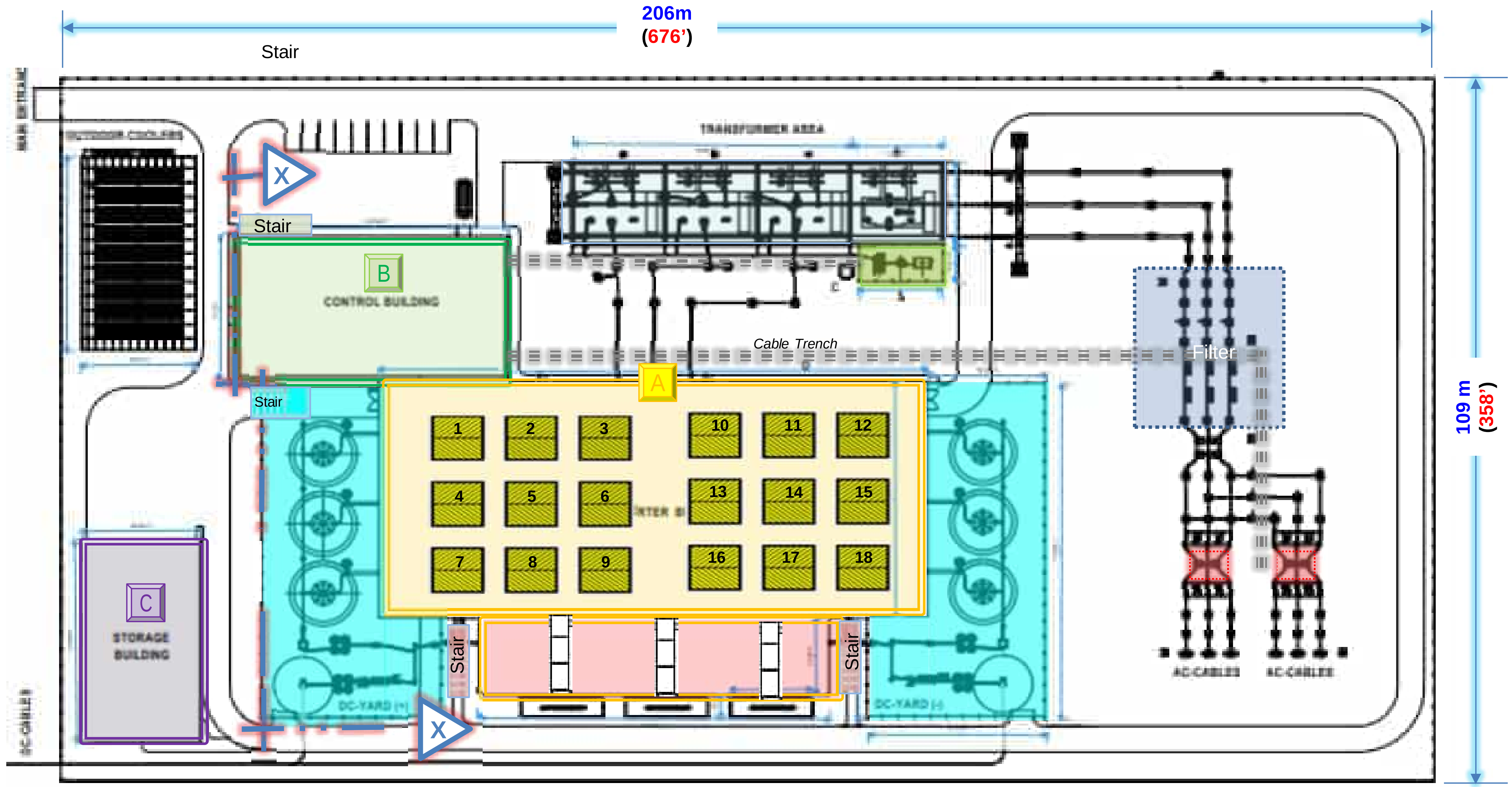
SCALE: NTS	

SKT No 27 of 12 Abril 25, 2024 REV. A



PLAN VIEW

Task	Task Description	QTY	Dimensions (ft) l	W	H
A	BUILDING				
1.00	Converter Station	1	265	120	14
2.00	Cooling and Aux Pwr Rooms	1	172	30	14
3.00	Control Building	1	133	74	14
4.00	Storage Building	1	60	102	14
B	DC HV EQUIPMENT :				
1.00	DC Air Core Reactors & Equipment :	2	58	120	12
a	[illegible]	2			
b	[illegible]	2			
c	[illegible]				
d	Surge arrester				
e	Bus /Main support structures				
C	AC YARD HV EQUIPMENT :				
1	Main power transformer	4			
a	Platform	1	151	42	14
b	Oil containment	4			
c	Blast rated fire walls	3			14+30
2.00	Dead tank circuit breaker	2	15	15	14
3.00	Disconnect switch (4 leg structures)	2	0.75	0.75	14
4.00	H-Frame (2 leg Foundations)	2	1	1	14
5.00	Bus support (1 foundation)	24	0.75	0.75	14
6.00	Bus support 3 phase (2 found. /1 struct)	11	0.75	0.75	14
7.00	Lightning masts (monopole)	6	1.5	1.5	80
8.00	Cable termination & surge arrester (2 Foundations each & 1 type structure)	2	0.75	0.75	14
9.00	Revenue Meter CT & PT (4 leg structures)	2	0.75	0.75	14
C	AC YARD HV EQUIPMENT AT POI (Astoria Substation East & West) :				
1.00	Cable termination & surge arrester (2 Foundations each & 1 type structure)	4	0.75	0.75	14
2.00	Revenue Meter CT & PT (2 legs structures)	4	0.75	0.75	14
3.00	Interconnection with existing busses	Lot			
D	AC LV COMPONENTS				
1.00	Station Service transformer (Pad Mounted)	2	12	12	14
2.00	Diesel generator & load bank	1	15	25	14
3.00	Trench (Primary & backup)	575'	2	4	
4.00	Manhole/Handhole	2	8	12	
5.00	Lighting pole	4	1	20	
E	FENCE & SECURITY EQUIPMENT :				
1.00	Pole for cameras/horn & lights	8	0.25	0.25	20
2.00	Heavy security gate	1			10
3.00	Card reader	2	0.25	0.25	5
4.00	Bollards and miscellaneous	8	0.25	0.25	4
5.00	Perimeter Fence & Gates (ft)	2068			8
F	MECHANICAL & WATER EQUIPMENT				
1.00	Cooler (HVAC Condenser)	1	57	50	24
2.00	Water tank (reservoir) in slab+piles	1	10	10	24

LEGEND:

A	STAR POINT AREA	C	HVAC COOLERS
B	EARTHING TRANSFORMER	D	SIEDEWAY
		E	SPARE TRANSFORMER
		F	AC CABLE SEALING ENDS

*No Towers: 3x 6 =18**

* To be validated

DRAFT : 00, 2020-09-16

REF: SIEMENS LAYOUT

NOTES	* Platform to be elevated 14' avove existing grade
AECOM Scope:	** Prepare the cost estimate for the below grade scope and extended up to the building floor, platform or equipment base elevated up to the flood level and include all steel support.
Reference:	The design criteria of this work follow the ConEdison standard practice for flood protection elevating equipment + 3 ft above the FEMA 100 year flood level.

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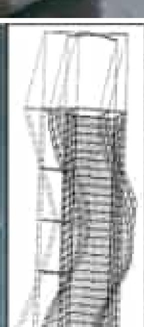
Project: EQUINOR CABLE ROUTING PROJECT

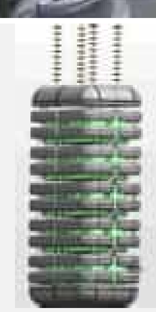
1,230 MW -320 KV DC SYM MONOPOL CONVERTER STATION LAYOUT

UNITED Engineers & Constructors

SKT No 28 of 12 Abril 25, 2024 REV. A

Cuarto de Valvulas Electronica





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Project EQUINOR CABLE ROUTING PROJECT

Typ. Converter Valve Hall

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