



GE Power's Grid Solutions

MODULAR TRANSPORTABLE SUBSTATIONS

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Reston, VA
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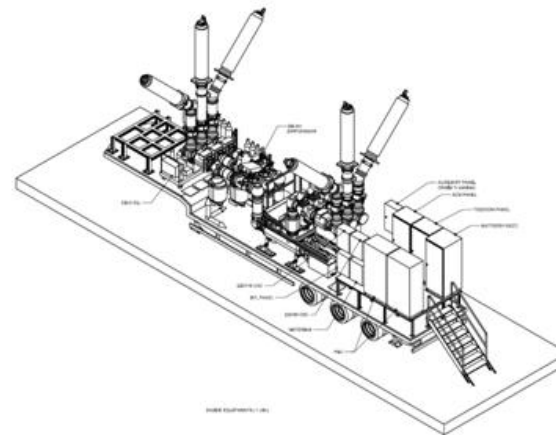
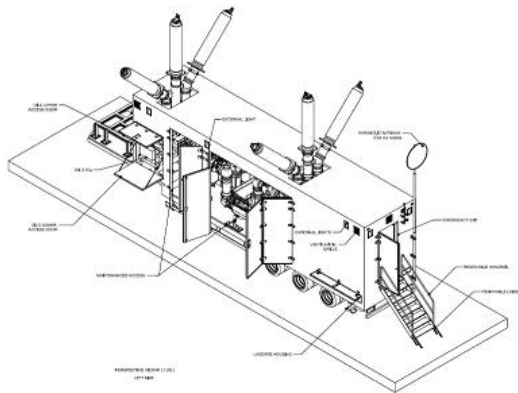


What is a Mobile Substation?

Definition

Mobile Substation is a SELF-CONTAINED TRAILER OR CONTAINER comprised of all the HIGH AND MEDIUM VOLTAGE equipment such a Power Transformer, Switchgear, Breakers, Metering Transformers, Surge protection, P&C panels, AC/DC Auxiliary Power...

The configuration of a mobile substation will require / may vary from customer needs and is determined by the Voltage Equipment, the Short Circuit level, the BIL of the substation, the MVA of Power Transformer and the number of circuit breakers.



Uses of Mobile Substations

❖ During Outages because of natural or unnatural Causes

- *Provide emergency and temporary load support to reenergize the power network in the event of catastrophic failure of onsite equipment.*

❖ During Periodic maintenance

- *In the event of refurbishment or maintenance for a complete or partial substation, mobile substation can help maintain continuity without any outage to consumer.*

❖ During an increase in production capacity

- *Provide temporary load support in case of an increase in production capacity during a given lapse of time. Eg. Add MVA rating to substation using mobile transformers for temporary period.*

❖ During a delay in a permanent substation project

- *In event of delay during a permanent installation project, Mobile substation cover the necessity to meet the commitments entered into and avoid penalties. Eg. Startup power for a power plant.*

❖ To overcome Space & Weather constraints

- *In event of installations with constrained spaces or adverse climate conditions, the use of Mobile substations reduce Installation & Commissioning Time. Eg. sandstorms*



Grid Solutions - Solutions unit in Madrid, Spain

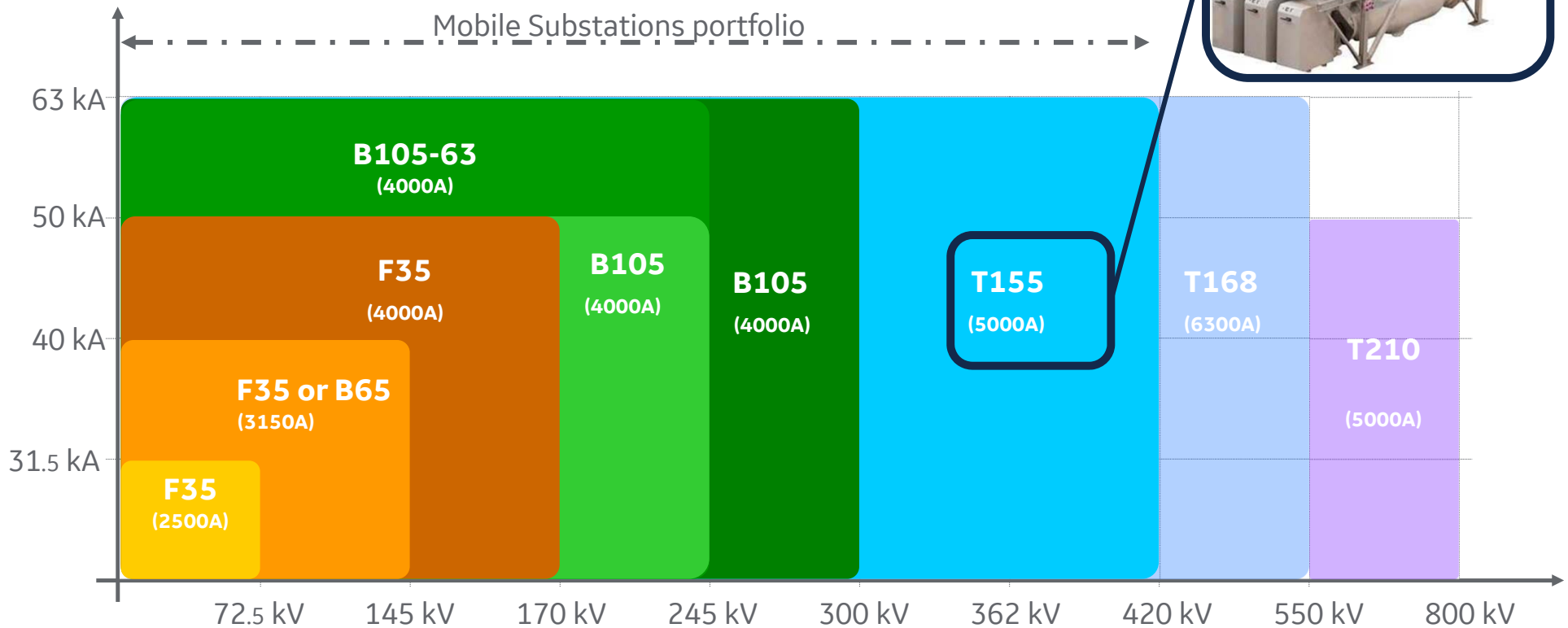
GLOBAL CENTER OF EXCELLENCE

FOR DESIGN, ERECTION AND TESTING OF MOBILE SUBSTATIONS

- *Activity* : Solutions Unit - Turnkey Projects
- First Mobile Substation delivered in 2002 - More than 16 years of experience
- Experienced Team in Mobile Substations
- *Covered Area* : Worldwide for Mobile Substations
- *Certifications* : ISO 9001, ISO 14001, OHSAS 18001

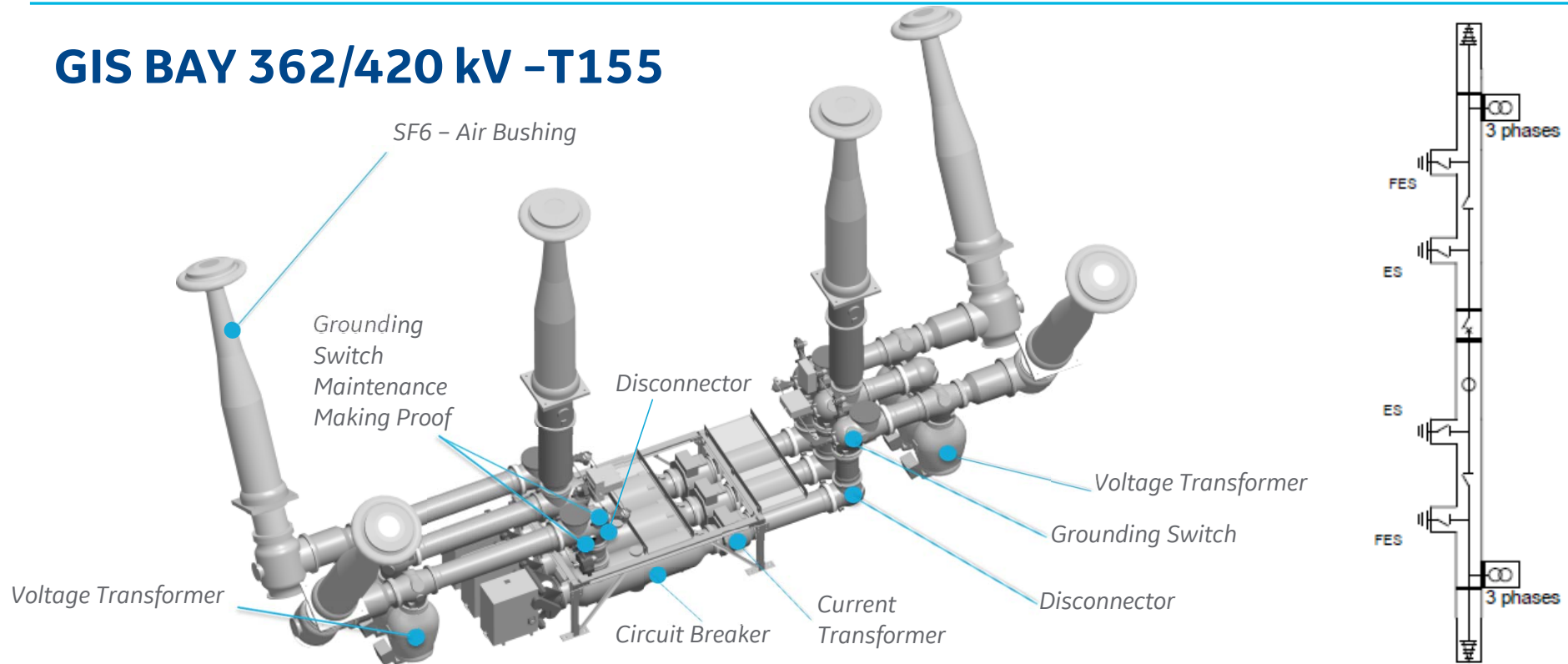


This is how we do it



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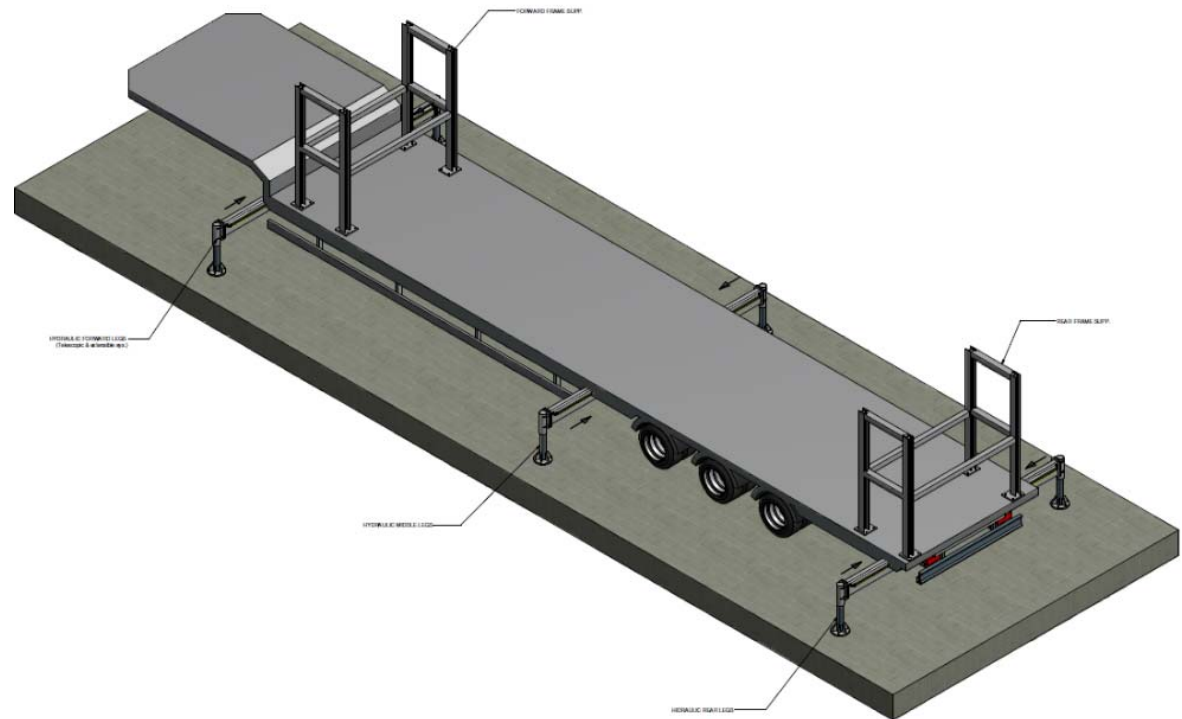
GIS BAY 362/420 kV -T155



This is how we do it

TRAILER DEFINITION

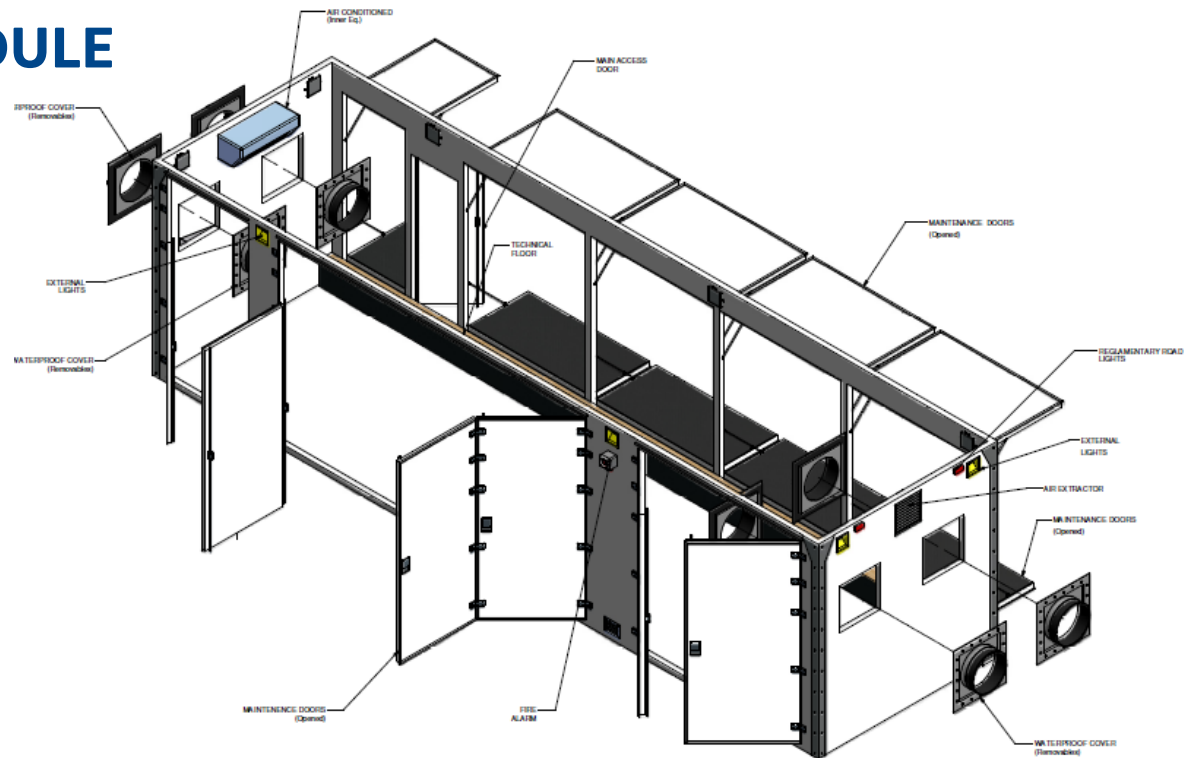
- *TRANSPORT REQUIREMENTS*
- *TREE AXLES GOOSENECK TRAILER*
- *MAIN DIMENSION*
 - *18,1 X 3 M*
- *9 T PER AXLE + 12 T 5^a WHEEL*
- *HYDRAULIC LIFTING SYSTEM*
- *FRAME SUPPORTS*



This is how we do it

ENCLOSURE FOR THE MODULE

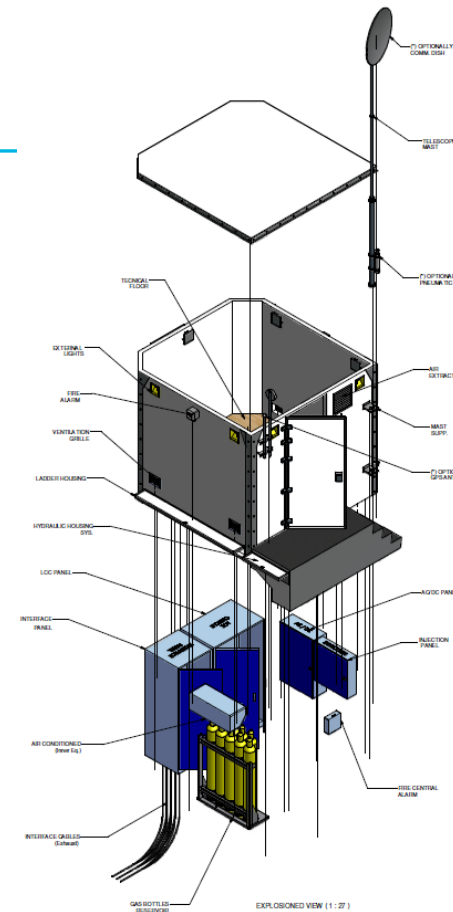
- UP-&-OVER PIVOT DOORS
- ONE & TWO PIECES PIVOT DOORS
- GENERAL PROTECTION RATING IP35
- HOLES FOR GIS BUSHINGS IP55



This is how we do it

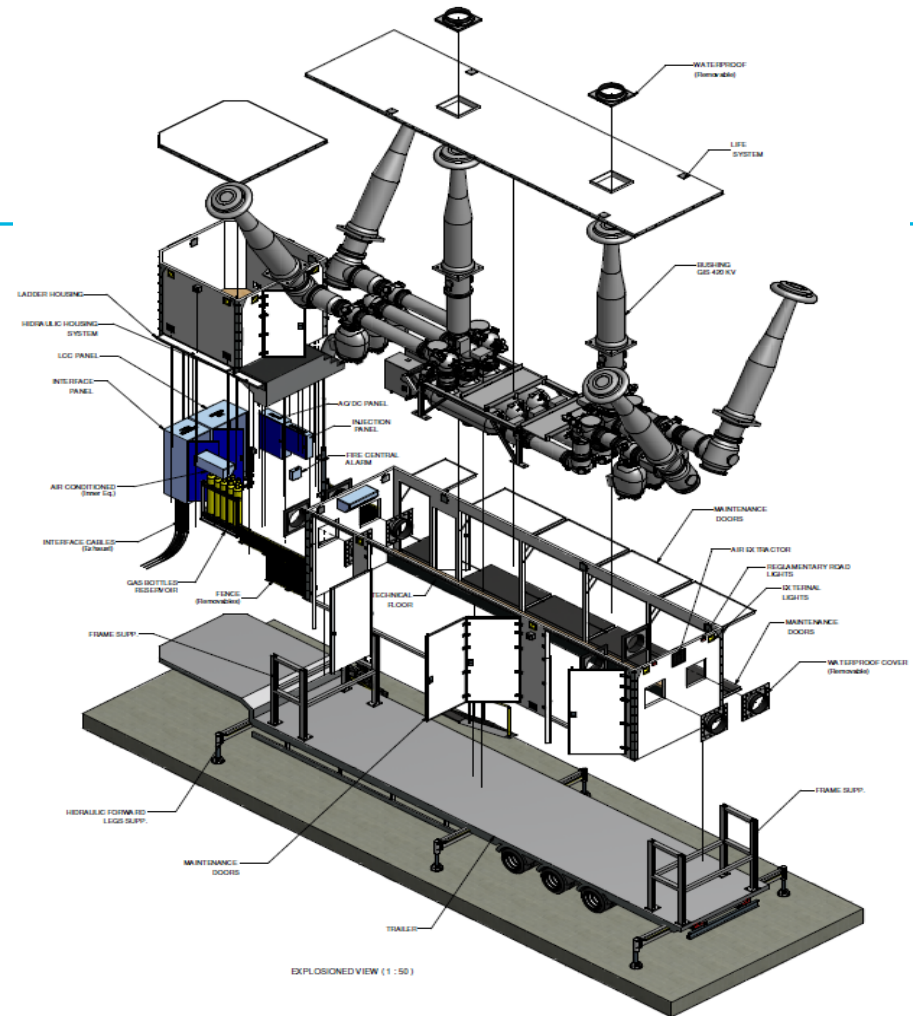
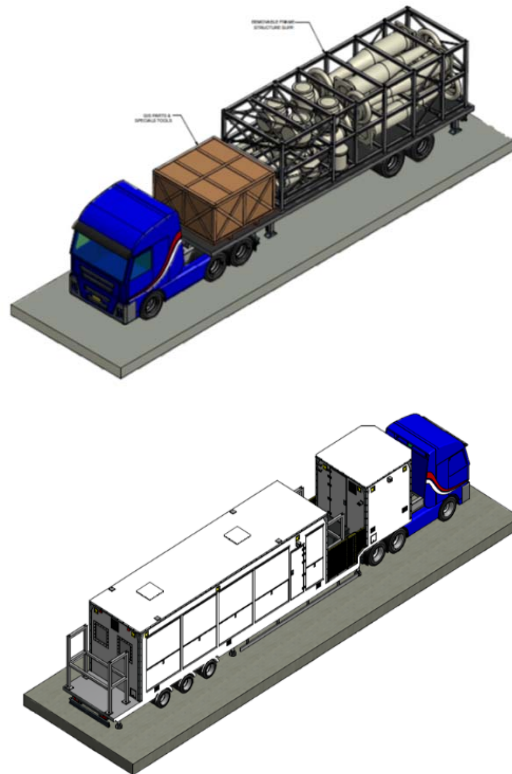
CONTROL ROOM

- *PROTECTION PANELS (DIFFERENT CONFIGURATIONS)*
- *AUXILIARY SERVICES*
- *BATTERIES & RECTIFIERS*
- *FIRE DETECTION SYSTEM*
- *SF6 BOTTLES*
- ...



This is how we do it

Example 362kV



References - Examples



>50 Mobile units

>19 Mobile GIS Units



ESBI Mobile Substation GIS 220 kV

Technical Characteristics & Installed Equipment

- **Client: ESB (Ireland)**
- **Technical data:**
 - **GIS 220 kV**
 - **1 bay (1 input 220 kV / 1 output 220 kV)**
 - **Air connection 220 kV input / output**
 - **One trailer 14.0 m(L) x 2.5 m(W) x 4.5m(H)**
 - **Total weight: 24.5 Tons**
- **Main installed equipment:**
 - **HV GIS: GE Bay B105 ($V_r = 245 \text{ kV}$ / $I_r = 2500 \text{ A}$ / $I_{sc} = 50 \text{ kA}$)**
 - **Auxiliary Services: Rectifier + Batteries + AC-DC Distribution Panels**
 - **GIS Local Control Panel + Protection and Control Panel**



REE Mobile Substation GIS 220 kV (3 units)

Technical Characteristics & Installed Equipment

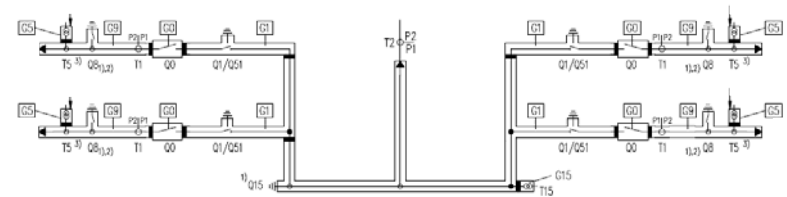
- **Client: REE (Spain)**
- **Technical data:**
 - **GIS 220 kV**
 - **1 bay (2 inputs 220 kV / 1 output 220 kV)**
 - **Isolated Cable 220 kV input / output**
 - **One trailer 13.6 m(L) x 2.5 m(W)**
 - **Total weight: 23 Tons**
- **Main installed equipment:**
 - **HV GIS: GE Bay B105 ($V_r = 245 \text{ kV}$ / $I_r = 3150 \text{ A}$ / $I_{sc} = 50 \text{ kA}$)**
 - **Auxiliary Services: Rectifier + Batteries + AC-DC Distribution Panels**
 - **GIS Local Control Panel + Protection and Control Panel (with RTU) + SCADA**



Fenosa Mobile Substation GIS 132-66 kV (4 units)

Technical Characteristics & Installed Equipment

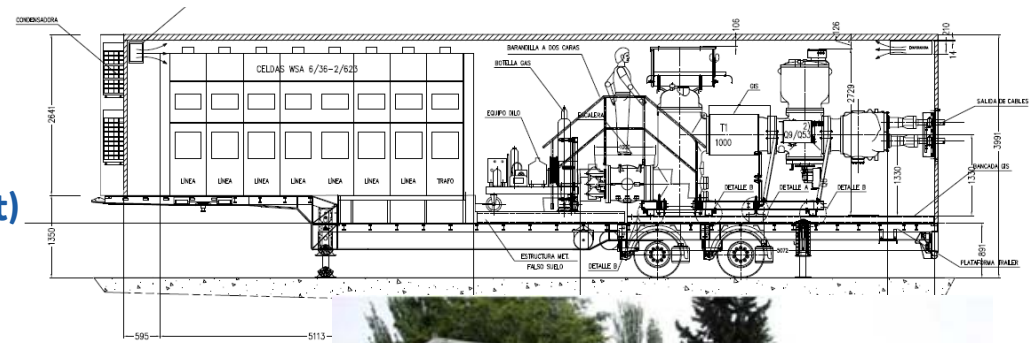
- **Client: Gas Natural Fenosa (Spain)**
- **Technical data:**
 - **HV GIS 145 kV-40kA**
 - **4 bays H4 (132 kV / 66kV)**
 - **Isolated cable 132/66 kV input / output**
 - **One trailer 13.6 m (L) x 2.5 m (W)**
 - **Total weight: 29.7 Tons**
- **Main installed equipment:**
 - **HV GIS: GE F35 (Vr= 145 kV / Ir=2000 A / Isc= 31.5 kA)**
 - **SF6 treatment equipment**
 - **Auxiliary Services: Rectifier+ Batteries**
 - **Combined LCC+P&C Panel, communications.**



Endesa Mobile 132-66 / 25-20-15 kV (4 units)

Technical Characteristics & Installed Equipment

- **Client: Endesa (Spain)**
- **Technical data:**
 - **HV GIS 132/66 kV isolated cable (input / output)**
 - **MV Switchgear 25-20-15 kV**
 - **One trailer 13.6 m (L) x 2.5 m (W)**
 - **8x 25kV Switchgear bays**
- **Main installed equipment:**
 - **HV GIS: GE F35 (Vr= 145 kV / Ir=2500 A / Isc= 40 kA)**
 - **MV Switchgear: 8 bays (Trafo + 7 Feeders) (Vr= 25 kV / Ir=1250 A)**
 - **SF6 treatment equipment**



E.ON Sweden Mobile 170-72.5 / 57.5-23-11.5 kV

Technical Characteristics & Installed Equipment

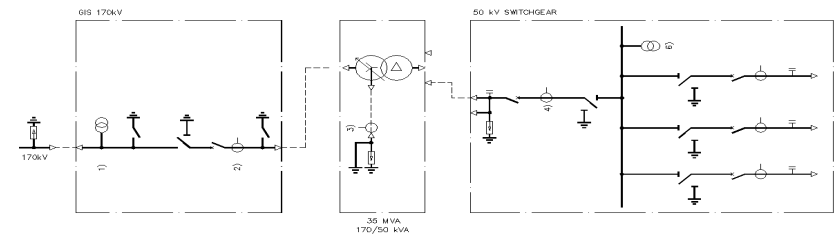
- **Client: E.ON (Sweden)**

- **Technical data:**

- **HV GIS 170 kV / MV 52.5 kV**
- **Maximum transformer power: 35MVA OFAF**
- **Isolated cable 170kV input / output, 52kV input / output**
- **One trailer 20 m (L) x 3.1 m (W)**
- **1 GIS 170kV container (with structures)**
- **1 52.5 kV Switchgear container (with structures)**

- **Main installed equipment:**

- **HV GIS: GE F35 (Vr= 170 kV / Ir=3150 A / Isc= 50 kA)**
- **Power transformer: 145kV (±15%)-72.5kV (±15%)/57.5-23-11.5kV, 35 MVA OFAF YNd5**
- **MV Switchgear: 4 bays (Trafo + 3 Feeders) (Vr= 52.5 kV / Ir=1250 A / Isc= 16 kA)**



Dominion Mobile Substation GIS 138 kV (2 units)

Technical Characteristics & Installed Equipment

- **Client: Dominion (USA)**
- **Technical data:**
 - GIS 145 kV
 - 1 bay (1 input 145 kV / 1 output 145 kV)
 - Isolated cable 145 kV input / output
 - One trailer 12.2 m (L) x 2.58 m (W)
 - Total weight: 23 Tons
- **Main installed equipment:**
 - HV GIS: GE F35 ($V_r = 145$ kV / $I_r = 2000$ A / $I_{sc} = 40$ kA) + SF6 treatment equipment
 - Auxiliary Services: Battery charger + Batteries + AC-DC Distribution Panel
 - GIS Local Control Panel + Protection and Control Panel.



Benefits of Mobile Substations



CIVIL WORKS



CIVIL WORKS ARE NOT REQUIRED



GREAT SAVINGS, COST AND TIME

FIXED INSTALLATION



MOBILE INSTALLATION



POSSIBILITY OF RELOCATION

LONG STARTING UP



SHORT STARTING UP



FACTORY TESTED

FIXED CONFIGURATION



FLEXIBLE CONFIGURATION



DIFFERENT CONFIGURATIONS

LONG DELIVERY TIME



SHORT DELIVERY TIME



POSSIBILITY OF STOCK - PLANIFICATION

DISMANTLEMENT COST



LOW DISMANTLEMENT COST



SUCCESSIVE APPLICATIONS



Lessons learned applied to HV GIS Mobile Equipment

❖ SAFETY.

- *Accessibility to increase safety of operation (corridors, access to drives).*
- *Trailer design → Split-doors that can be used as platforms for operation.*

❖ FAST COMMISSIONING ENERGIZATION.

- *Is there any way to reduce connection times: HV Cable plug in connection, SF6-Air bushings*
- *optimize gas handling (reduce time, accessibility)*
- *Hi-Pot of equipment through the Power VT's (feasible up to 245kV – depending on layouts)*

❖ Ease of USE / DEPLOYMENT.

- *Compact design to allow transportation of trailer without escort*
- *When is it no feasible does a split design provide a better solution? Separate containers for HV and MV, container for LV and trailer for HV.*
- *Possible customization of LV Panels (P&C) to adapt to each application*

❖ Possible several bays into a single trailer (depending on ratings).

- *4 bays at 69kV Ring or 4 bays at 145kV Single busbar*



Mobile Substation – CIGRE and IEEE work

CIGRE: a technical brochure is in preparation within the B3 Subcommittee.
“WG B3.41 Mobile Substations Incorporating HV GIS - Design Aspects”

IEEE : new guide in preparation within Substation K0 Subcommittee:
“WG K18: Guide for the Application of Mobile Gas-Insulated Substations
Rated Above 52kV”



Q&A



