

**RUS 2006
Electric Engineering
Seminar**



**Modular Substations
An Innovative Approach**



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Presentation Program

- Air Insulated Modular Substation Concept
 - What is a Modular Substation
 - Modular Substation Factory Assembly Process
 - Site Installation of Modular Substations
- Modular vs Conventional Substation Economics
- Turnkey Modular Substation Projects
- Site Assembly of a Modular Substation

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Coop Market Drivers to Modularization of Substations

- Meeting Growth Demands
 - City's expanding to Coop territories
 - Industrial loads connecting to Coop Systems
- Permitting Process
 - Property acquisitions & permitting delays
 - Interconnect Right of Way delays
- Standardization
 - Ease of Operation
 - Base Design
 - Minimized inventory of spare parts
 - Lower costs

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Modular Substations

Open Air bus Insulated Secondaries



Open Air bus Insulated secondaries

Air Insulated metal enclosed bus



Indoor Gas Insulated Bus

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MODULAR SUBSTATION CONCEPT

What is a MODULAR Air Insulated Substation ?

- A completely engineered substation system
- Skid mounted substation, factory-assembled and functionally tested
- Custom-designed, built and installed using a standard process
- Flexible design to accommodate RUS & Coop detail requirements
 - All voltages, all ratings, all configurations
 - RUS approved equipment & materials



A traditional substation, just put together differently

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Modular Open Bus Air Insulated Substation 115kV /25KV 25MVA



**Radial Primary Tap /
Main & Transfer Secondary, feeder regulated**



Modular Open Bus Air Insulated Substation 115kV/12.47kV 25MVA



Stepped Site , underground transmission connection



Modular Air Insulated Substation 115kV/25KV 20MVA



Looped Primary / Main & Transfer Secondary, Bus Regulated



87.5 MVA 138 kV / 34.5 kV Modular Substation



Open air insulated single bus secondary,
overhead feeder exits



Modular Air Insulated Substation 7.5MVA 69Kv/ 25kV



**Radial Tap, Main & Transfer ,bus regulated
Underground feeder exits** **ABB**

MODULAR SUBSTATION ASSEMBLY

Typical Assembly Process - Assembly of Skids



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15kV Modular Skids during Factory Assembly Process



All switches ,bus and connections are factory installed

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Substation during factory assembly



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Typical Assembly Process - Cable Termination



Cable Pulling

Cable Terminating



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Control Room Control & Protection Panels



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Modular Control Building & Interface Panels

Internally pre-wired



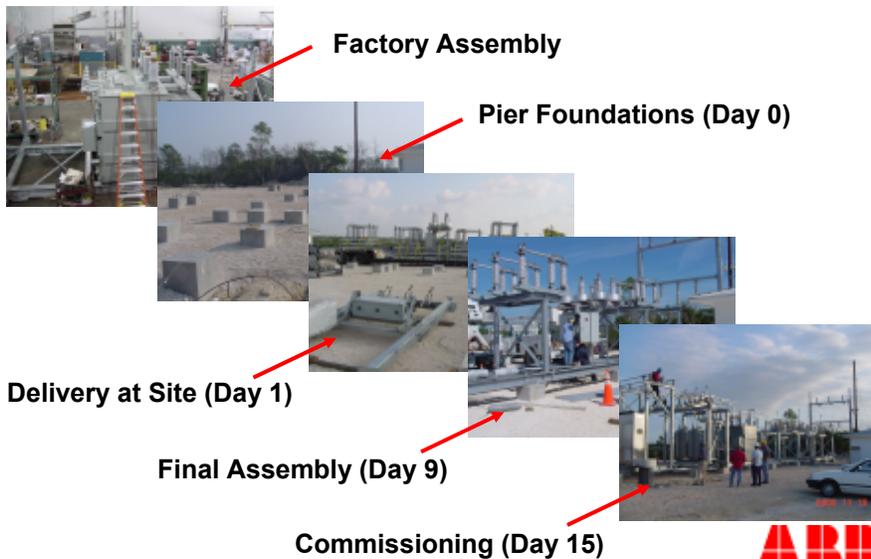
External wiring pre-made and tagged ready to ship

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Recloser Skid in transit to site



Modular Substation: Start to Finish in 8 months or less

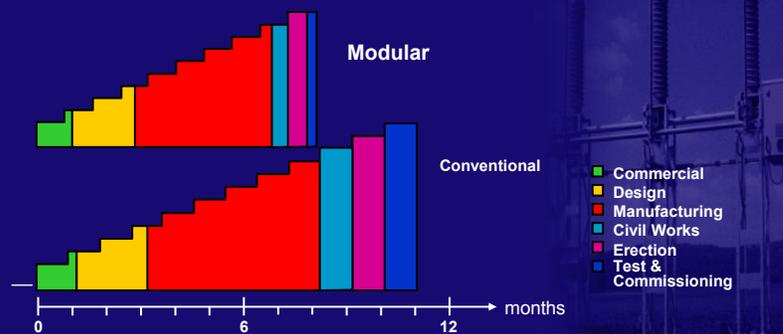


MODULAR vs CONVENTIONAL ECONOMICS

Modular Substation Advantages

MODULAR APPROACH

- Up to 35 % overall project time savings
- Reduced on site installation & Commissioning time



Modular vs Conventional -Civil Works



Pier type foundations

• Modular :

- Skids support Equipment
- Foundations support Skids
- Less Foundations
- Skid has built in cable tray system
- Minimized underground conduit

• Conventional:

- Foundations support equipment
- Foundation support structures
- Need underground conduit to interconnect control cabling

•MODULAR BENEFITS:

- Up to 40% less cost in foundations and conduits



Modular vs Conventional - Installation



Modular

- Factory Skid Assembly & pre-wiring
- Site assembly in 1-2 weeks
- up to 75% less installation & supervision cost
- Minimized Weather Risk



Conventional

- All structural and equip assembly at site
- All buswork, connections & wiring made at site
- Weather dependent
- Longer Site Time & Higher costs



Modular vs Conventional - Testing & Commissioning



Modular

- Wiring verification at factory
- Site wiring functional testing minimized to hours
- Buswork and connections verified at factory and rechecked at site
- 75% less verification time at site

Conventional

- All wiring installed & verified at site. Highest potential for delays and rework
- All buswork, connections made and verified at site
- Weather dependent
- Longer Site Time & Higher costs



Modular Substation Projects (2001- 2005)

■ Utilities:

■ Coop's:

- | | |
|---------------------------------|------------------------------|
| ■ San Isabel (SIEA), Pueblo, CO | 5-115kV Modular Substations |
| ■ Gunnison (GCEA), CO | 115KV Modular Substation |
| ■ Kit Carson (KCEC), Taos, NM | 69/25kV Modular Substation |
| ■ Jemez (JMEC) Espanola, NM | 69/12.5kV Modular Substation |
| ■ West Plains Electric, ND | 42kV Modular Substation |

■ IOU's:

- | | |
|------------------------|------------------------------|
| ■ Keyspan, Long Island | 14-69kV Modular Substations |
| ■ Duke Power | 100kV Modular Substation |
| ■ TXU, Dallas, TX | 3- 138kV Modular Substations |



ABB Turnkey Projects - cont'd

■ Industry:

- Georgia Pacific, Lynchburg, VA 69 kV Modular Substation
- Walgreens, Toledo, OH 115kV Modular Substation
- eCorp, Owego, NY 115kV Modular Substation
- Nippon, Dallas, TX 138kV Modular Substation
- Bristol-Myers Squibb, NJ 69kV & 115kV Modular Substations

■ Developers:

- RES Wind, McCamey, TX 6- 138kV Modular Substations
- UPC Wind, Hawaii 1- 69kV Modular Substations
- RES, Sweetwater, TX. 1- 138kV Modular Substation



Modular Substation Project during Site Installation



Installation Preparation

May 5, 2003

Day 1 6:00 AM



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Arrival of Control Building Skid

May 5, 2003

Day 1 6:30 AM



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Arrival of 12.47kV Feeder Skid



Unloading Building Skid



Unloading Skids

May 5, 2003

Day 1 8:35 AM



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Unloading Recloser Skid

May 5, 2003

Day 1 9:45 AM



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Unloading Regulator Skid

May 5, 2003

Day 1 10:15 AM



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Assembling Low Side Modular Skids

May 5, 2003

Day 1 11:30 AM



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Completed Low Side Modular Skid Assembly

May 5, 2003

Day 1 12:15 PM



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End of Day One

May 5, 2003

Day 1 5:00 PM



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End of Day One

May 5, 2003

Day 1 5:00 PM



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Start of Day Two

May 6, 2003

Day 2 7:00 AM



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Assembling Low Voltage Bus

May 6, 2003

Day 2 9:00 AM



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Assembling 115 kV Circuit Switcher

May 6, 2003

Day 2 1:30 PM



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End of Day Two



Assembling LV Bus



Assembling HV Bus Work

May 8, 2003

Day 4 2:00 PM



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Completed Bus Work

May 9, 2003

Day 5 2:00 PM



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Completed Regulator Maintenance Skid

May 9, 2003

Day 5 2:00 PM



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115kV /12.5kV 25MVA Modular Substation

