

All-Superconducting Substation

An HTS System Integration Concept

by

CSAC

General Concept

- Substation comprised of all superconducting power components
 - Transformer, FCL, μ SMES, Cabling
 - (Turbine Generator Rotor)
- Single Cryostation Support
- "Full Quadrant" Power
- Uninterruptible Substation Power
 - The EPRI UPS Substation Project Extended

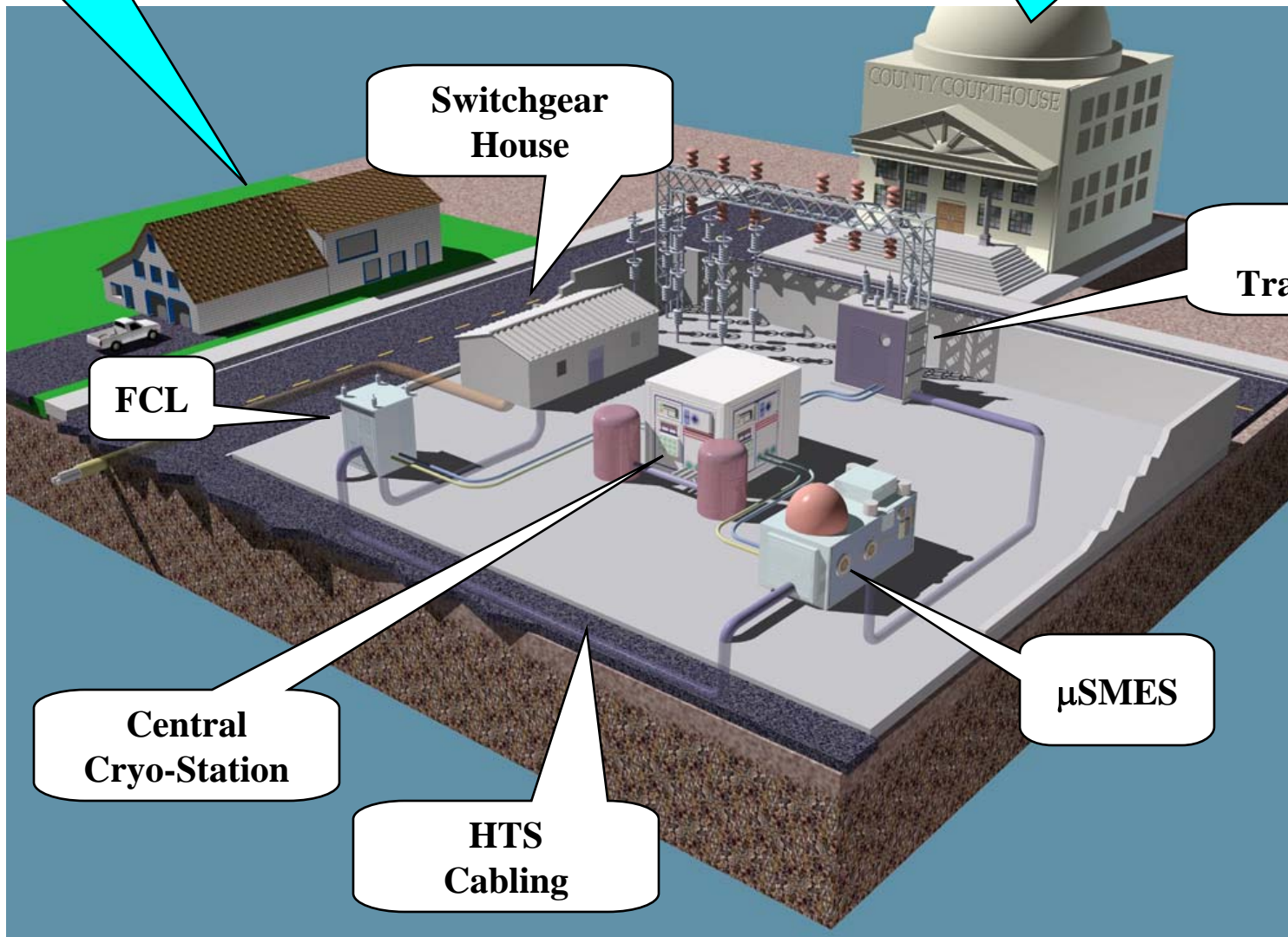
Substation Specifications

Power Capacity	100 MVA
Voltage	24 kV
Area	40 x 60 m²
Transformer	100 MVA, 3ϕ
FCL	3 @ 30 MVA
SMES	3 @ 3 MJ (30 MVA)
Cabling	100 MVA, 3ϕ, 500 m

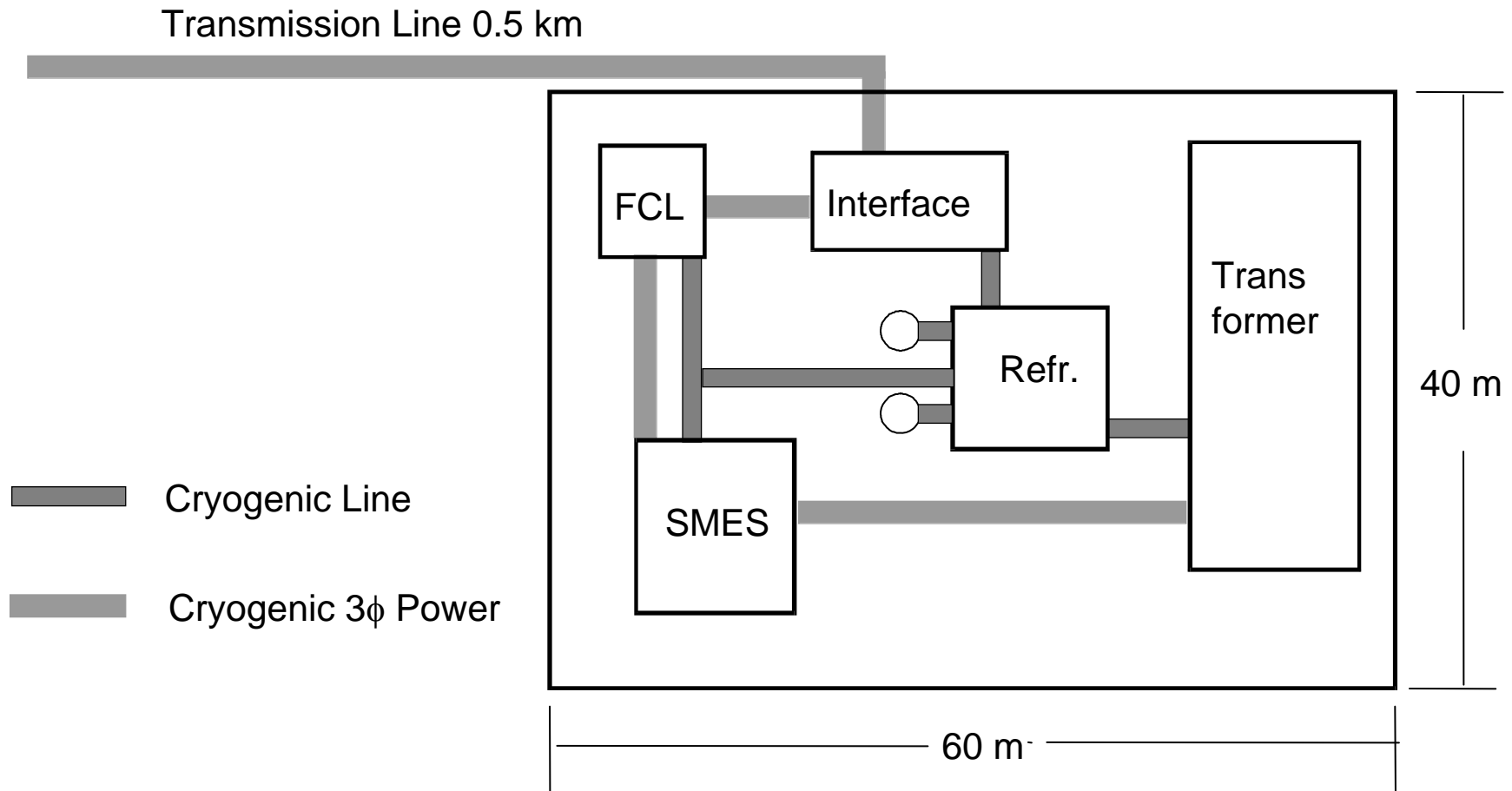
Legend

Courthouse where you can sue your local utility when the lights go off

Nice Family House



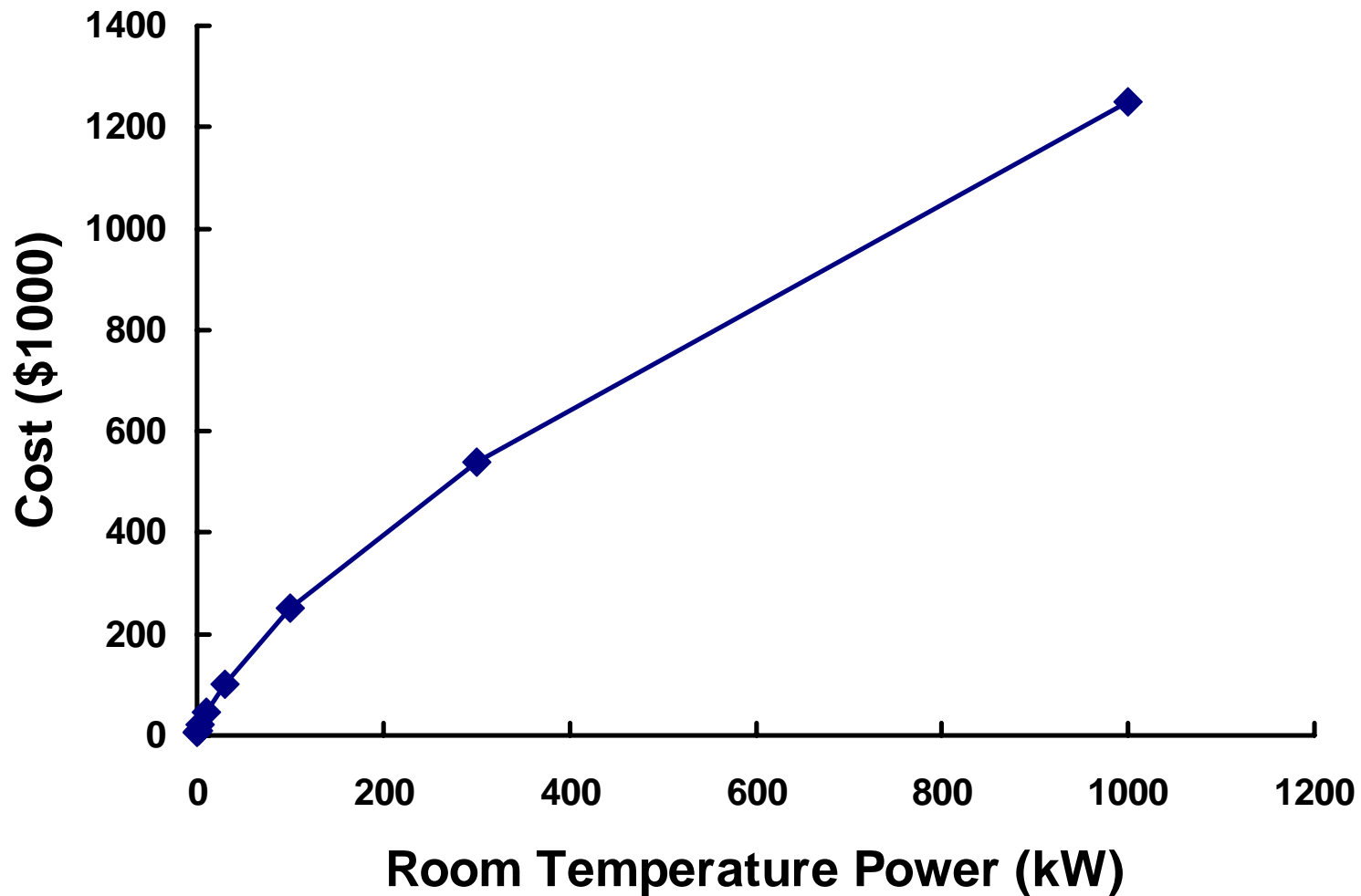
Super-Sub Plan View Scale/Dimensions



HTS Component Cryo-Budget

Component	Heat Load Range	Heat Load Design
<u>Transformer</u>		
30 K	150 - 400 W	250 W
77 K	500 - 800 W	600 W
<u>Fault Current Limiter</u>		
30 K	75 - 300 W	200 W
77 K	400 - 1000 W	700 W
<u>SMES</u>		
20 K	20 - 70 W	50 W
77 K	75 - 300 W	200 W
<u>Transmission Line</u>		
30 K	5 - 15 W/m	3000 W
77 K	5 - 10 W/m	3000 W

Cryoplant Cost vs Power



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Net CryoPower/Cost

Component	300 K Cryopower	Cryo Cost
Transformer	240 kW	450 k\$
Fault Current Limiter	240 kW	450 k\$
SMES	12 kW	50 k\$
Transmission Line	260 kW	500 k\$
Total—Separate Refrigerators	752 kW	\$1450 k\$
Super-Sub single Refrigerator	700 kW	\$1000 k\$

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30 % !

Conclusions

- Tangible energy/cost savings accrue from systems matching and cryo-integration of individual components (e.g., eliminate 300 K terminations)
- Commercial HTS power components will be emerging from DOE SPI
- System integration of HTS could play key role in addressing the President's Critical Infrastructure Directive

Proposal

- DOE SPES sponsor design study on integrated HTS power facility (e.g., "Super Substation")
- Two SPI teams solicited/selected competitively as additions to FY00/01
- \$500 K ea. (\$1M total), 1 Year

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JPEG color concept of the
All-Superconducting Substation
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