PUP – Technical Considerations

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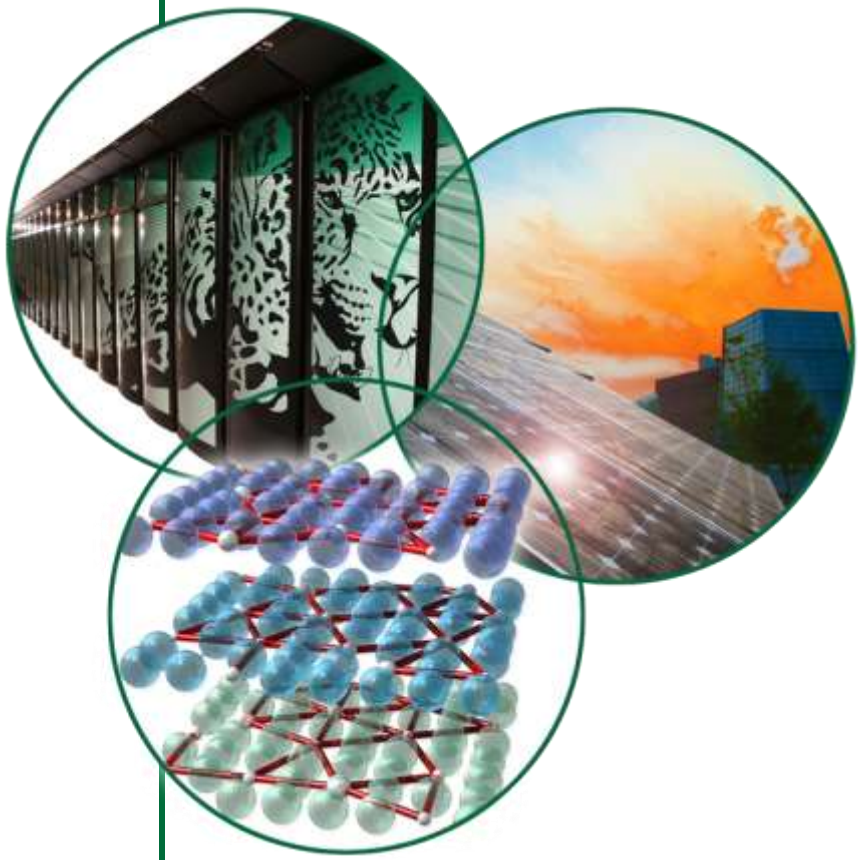

U.S. DEPARTMENT OF ENERGY

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High Level Parameters

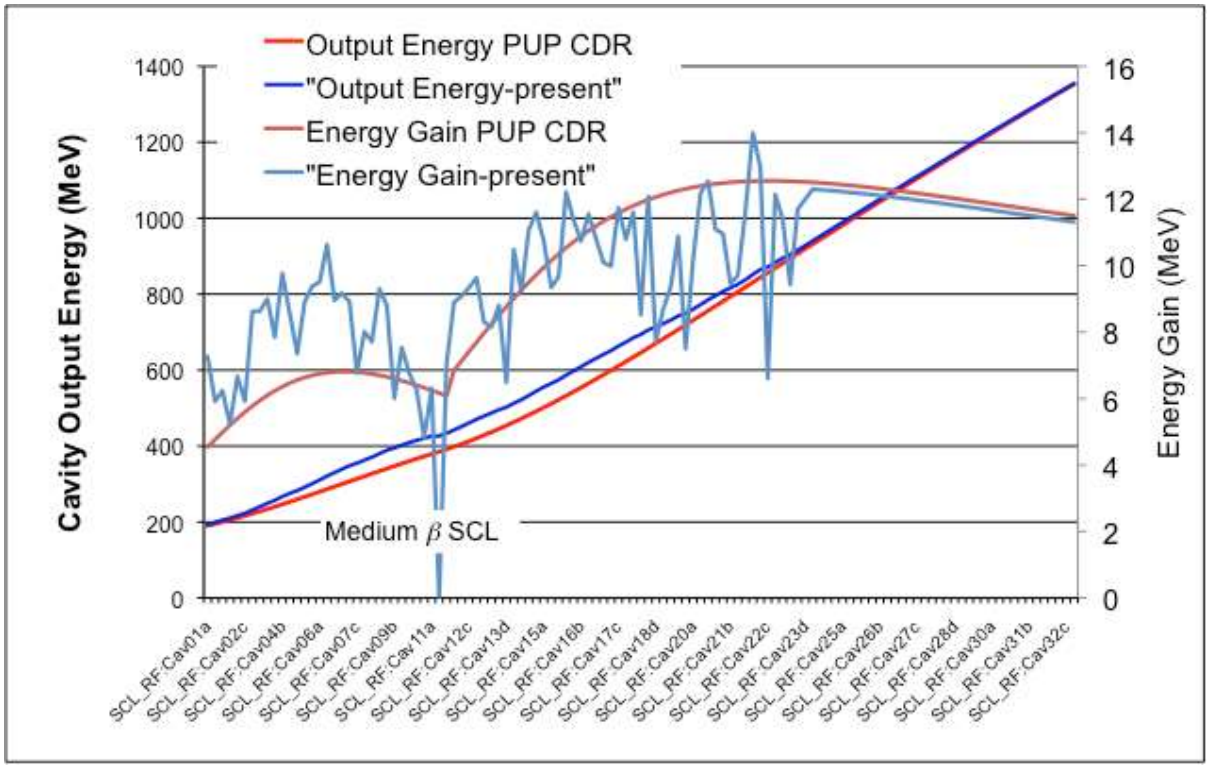
Parameter Comparison	SNS Project Baseline	Present Operation (best to date)	Energy Upgrade (PUP)	PUP + CUAIPs
Beam kinetic energy, MeV	1000	928	1300	1300
Design goal beam power, MW	1.4	1.03	1.8	3
Minimum beam power, MW	1			2
Linac beam duty factor, %	6	5	6	6
Average H- current, mA	26	24	26	42
Peak H- current, mA	38	38	38	59
Linac beam pulse length, ms	1	0.82	1	1

- **PUP is an energy upgrade only, with a 30% power increase**
- **CUAIPs provide another ~ 60% power increase**
  - **Make sure PUP in-tunnel components can handle current upgrades**

Strategy for Upgrade Plans

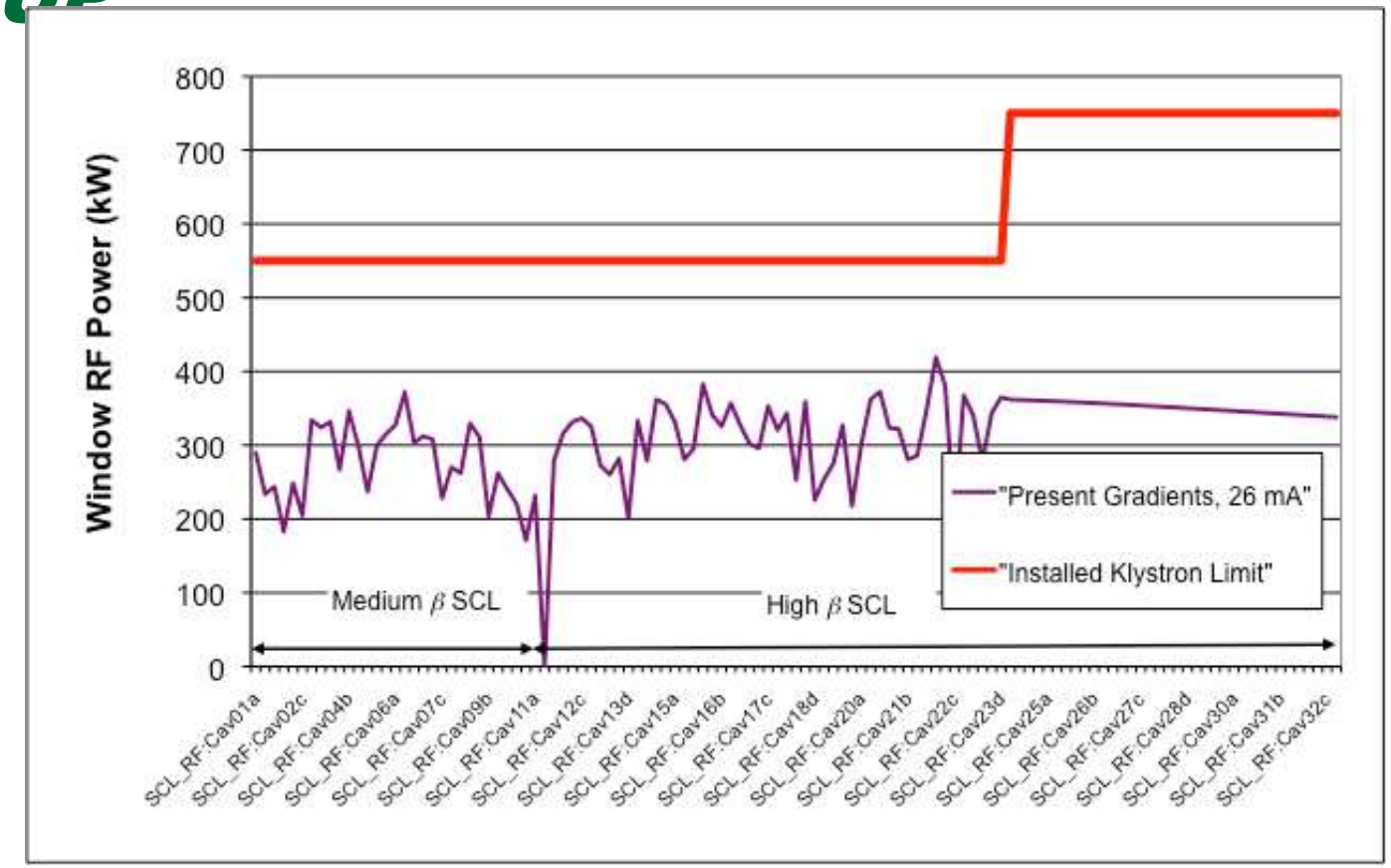
- Original CDR was based on extrapolations from SNS baseline design parameters
  - We are not operating the accelerator exactly as per design
  - E.g. beam energy is 930 MeV
- We have data now on the operational requirements for 1 MW beam
- Linac Requirements flow
  - Beam parameters ➔RF requirements ➔ modulator requirements
- Electrical and cooling requirements for PUP are also being prepared based on present experience
  - Magnets, RF etc.

Superconducting Linac, Energy: Where Are We Now? … *Good shape*



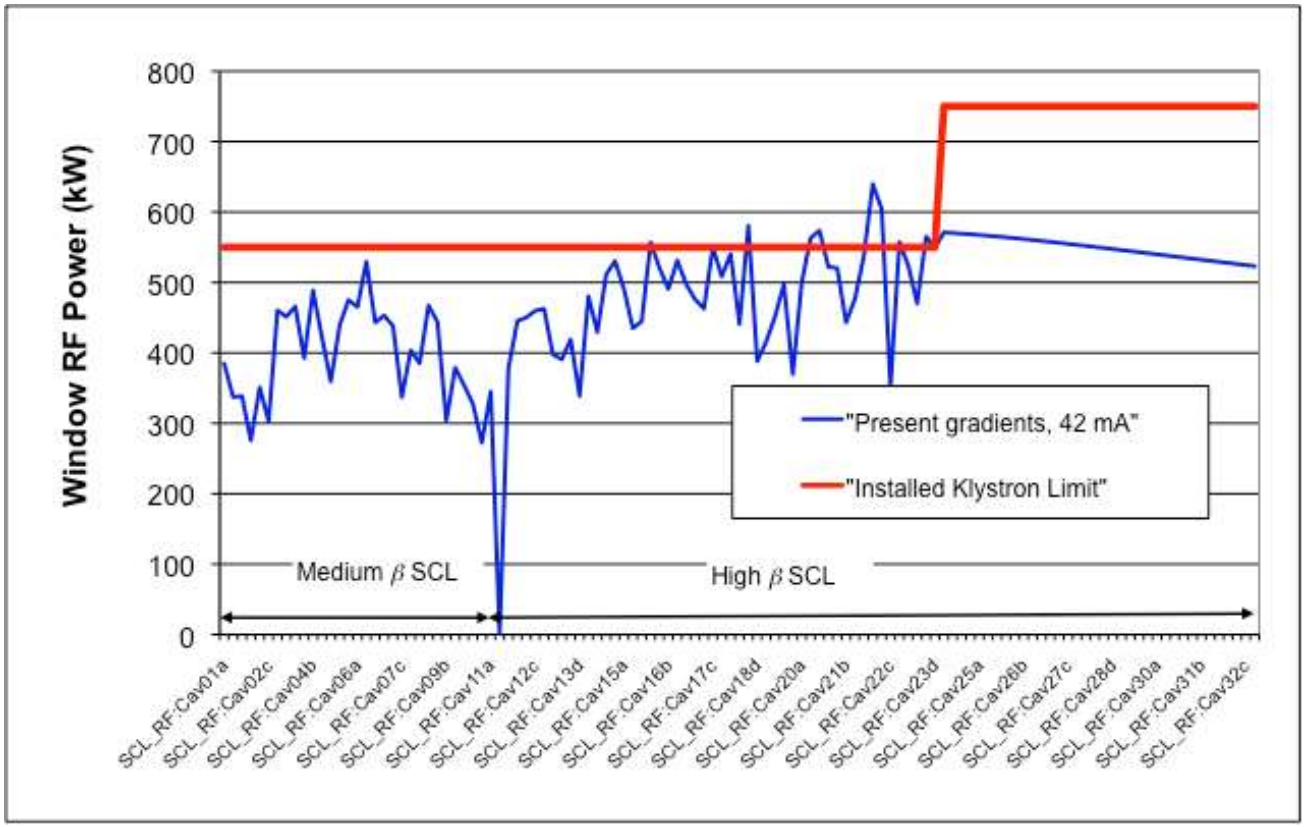
- **Existing average high beta cavity gradient is close to that needed to reach 1.35 GeV with 9 cryo-modules**
  - **New high beta cavities need E_{acc} = 14 MV/m**
  - **Present high beta average = 12.8 MV/m, PUP CDR assumed 13.8 MV/m**

Superconducting Linac, RF Power: Where Are We Now?... *Good shape for PUP*



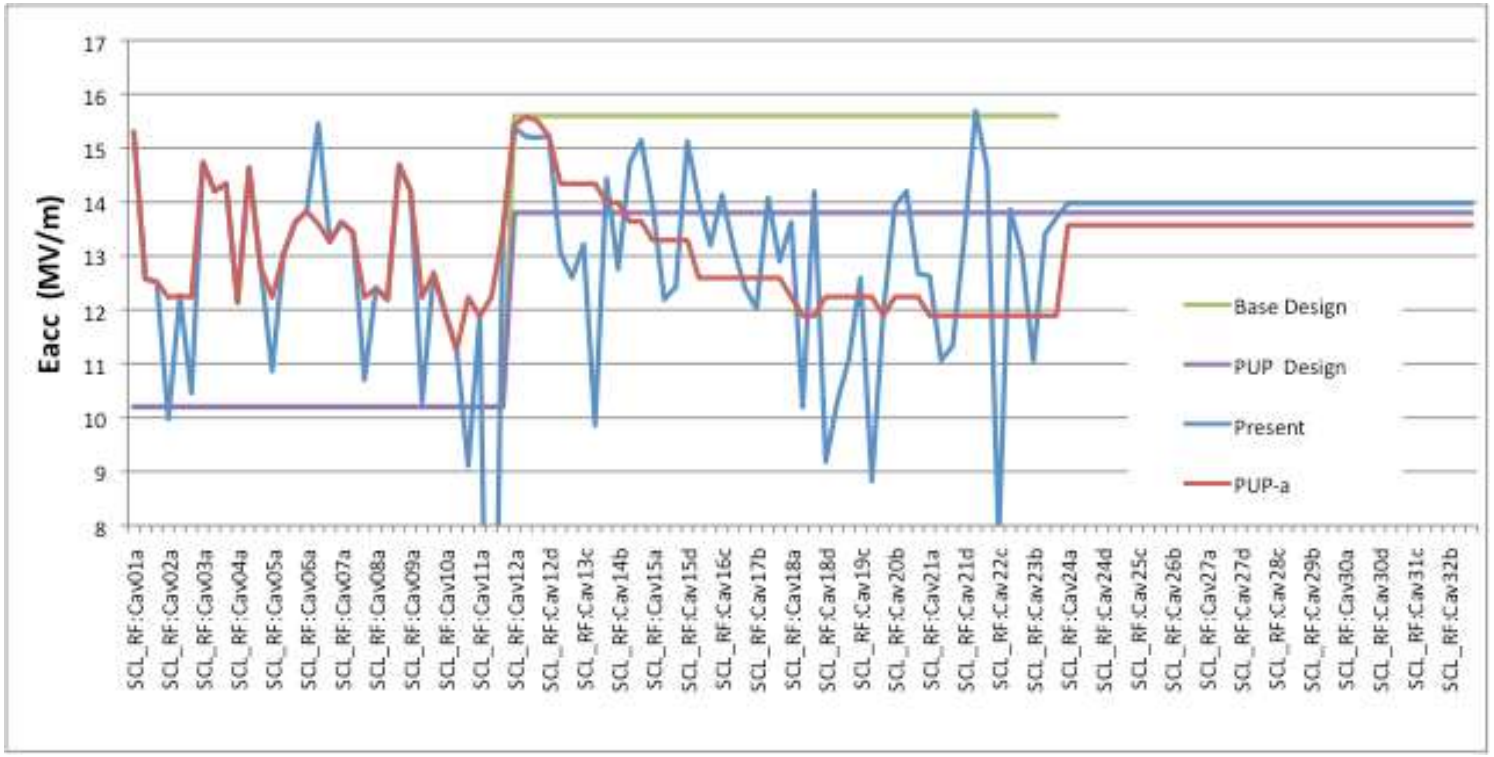
- **Using the PUP cavity gradients, the present RF equipment is sufficient for 26 mA**

Superconducting Linac, RF Power: Where Are We Now? ...*For CUAIP some challenges*



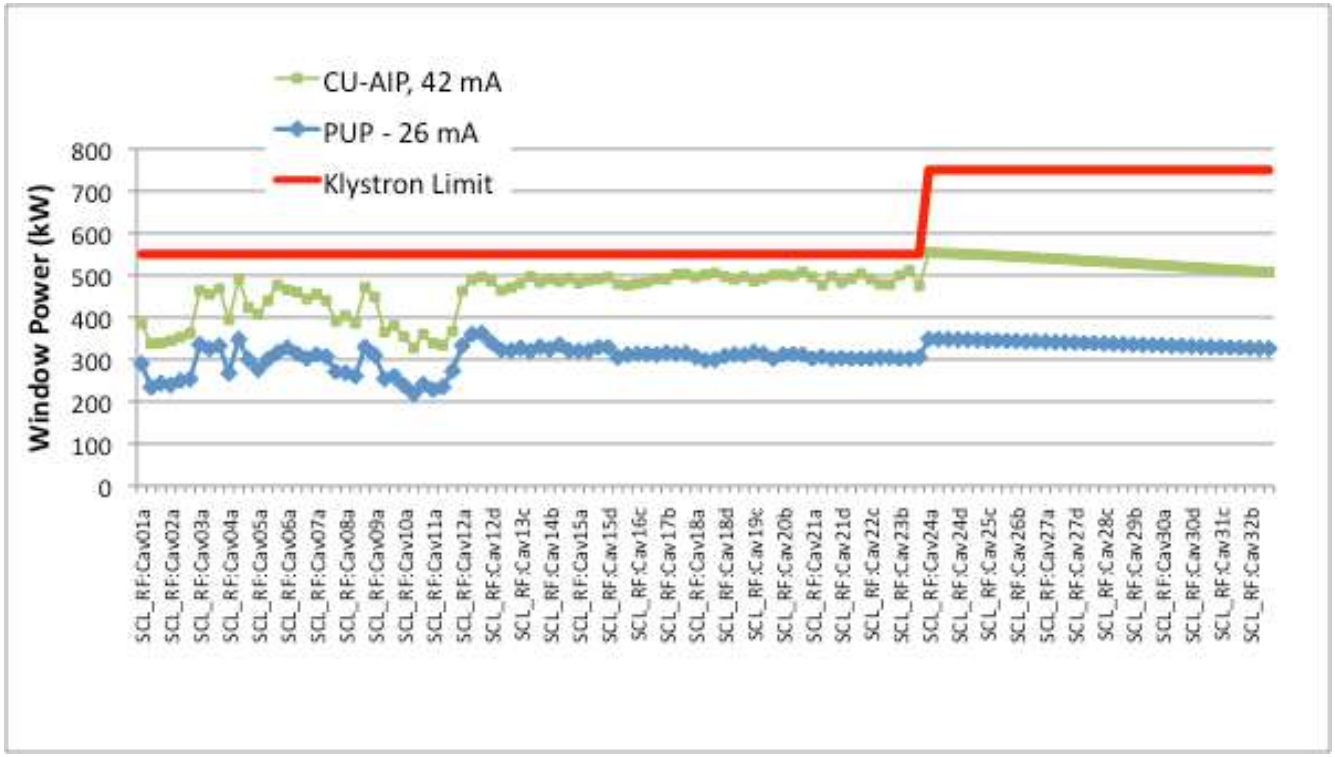
- **Simply running cavities as we do today presents RF challenges at higher currents**
  - **Klystrons, couplers**

SCL Gradients: Strategy to Minimize Impact of Higher Power



- Tailor the operational voltage to minimize the impact on the RF power requirements
  - Needs improvements of some existing cavities (plasma processing)
  - New cavities will operate at higher gradients than existing ones

Superconducting Linac: RF Power



- Minimize the RF Impact for higher current
  - Plasma process the poor performing cavities
  - Decrease gradients of higher performers
- New cavities should be capable of operating at higher power

Superconducting Linac Limits: Energy and Power

- We can get 1.3 GeV operating with similar cavity gradients as we operate with now
  - Also get 50 MeV extra as reserve for problem cavities
  - Energy itself is not a big stretch

- Existing RF power equipment is adequate for PUP (26 mA), but CUAIP (42 mA) is more challenging
  - An optimized scenario is identified to mitigate the RF requirements
  - Modest coupler R&D efforts now for equipment to be installed in the linac will allow 42 mA operation with minimal operational impact
  - Also need cavity plasma processing to improve performance of poor existing cavity performers for 42 mA operation

Ring Injection is More than a Simple Scaling Exercise

- **This is a complicated part of the Ring**
- **The initially installed SNS project equipment had issues**
  - **We have learned lessons and developed modeling capability in the process of improving this equipment**

Summary

- Identified a path forward based on operational experience
- The PUP energy upgrade does not require significant increase over presently achieved equipment performance