360kV Power Supply Enclosure

Xelera Research, Internship

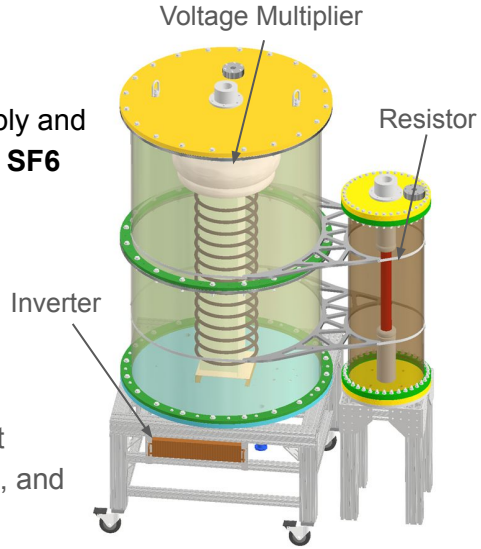
Project II

Purpose: Design High voltage enclosure for **360 kV, 2 kW** power supply and a **50 MΩ** current-limiting resistor that can be **evacuated** and filled with **SF6 gas at 10 psig** to prevent electrical arcing

Contributions: Structural design, electrical integration, manufacturing

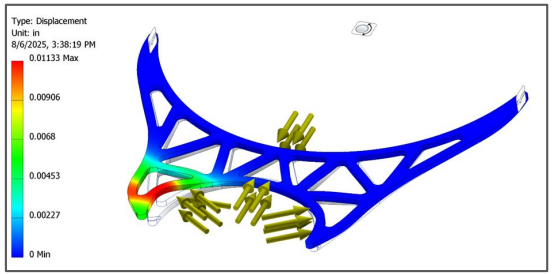
Technical details:

- 7.25” gap from charged surfaces derived from Paschen curve and validated with **Poisson Superfish FEA**
- Used **hand calculations** and **Inventor FEA** to design structure that maintains large safety factors against flange deflection, hoop stress, and vacuum buckling
  - ➢ Vacuum-rated burst disk prevents overpressurization
- Serviceable design separates power supply and resistor, supported on an 80/20 frame with standardized KF40 vacuum and electrical interfaces
- **Custom HV connections** between components and HV feedthroughs that prevents field concentration
- **Set up 3 axis CAM** to machine wheel mounts, resistor tank mount, and burst disk flanges with **Haas CNC**
- Created **engineering drawings** for custom flanges and tubes

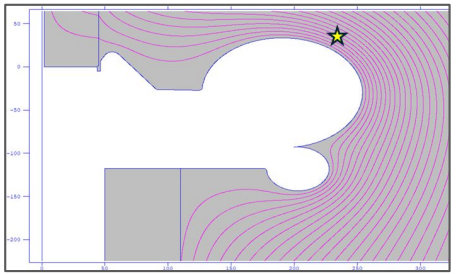


Full CAD model

Assembled power supply system



Mount deformation for 1200 lbs laterally



Poisson Electric Field Model

360kV Power Supply Enclosure *(Cont.)*

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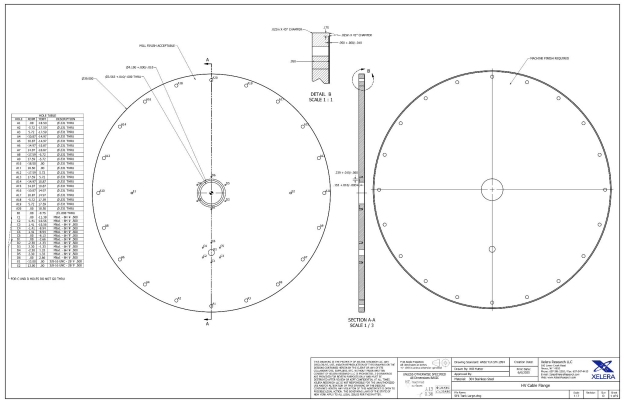


HV Cable Flange Drawing

Flange Deflection: $y_{max} = k_1 \frac{wR^4}{Et^3}$

For t = 1in, w = 20psi, R = 17.5in ->

y_{max} = 0.01265in

Stress on flanges: $S_{max} = k \frac{wR^2}{t^2}$

For t = 1in, w = 20psi, R = 17.5in ->

S_{max} = 4117 psi

Vacuum buckling: $P_{cr} = KE\left(\frac{t}{D}\right)^3$

For t = 0.25in, D = 35in ->

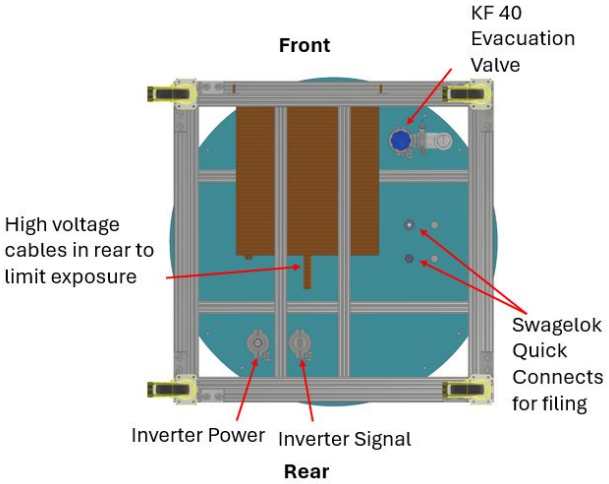
P_{cr} = 272 psi, Safety Factor = 13.6

Hoop stress: $S = \frac{pr}{t}$

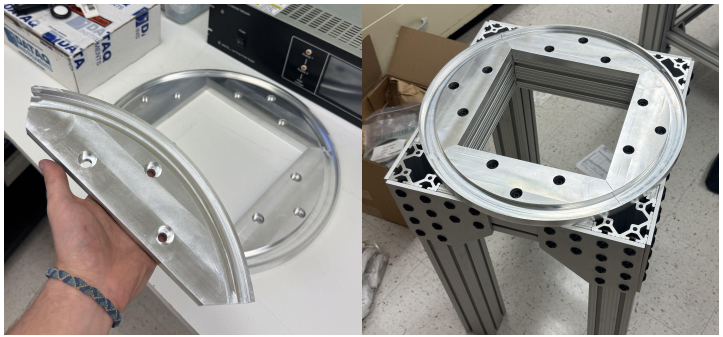
For t = 0.25in, r = 17.43in, p = 20psi ->

S = 1394 psi, Safety Factor = 32.25

Project II

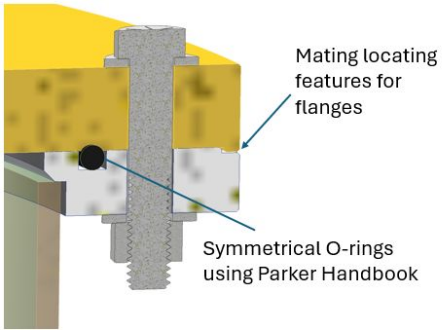


Selected and integrated feedthroughs



Personally machined custom mounts for resistor tank

Tank components



Custom 38” Flanges welded to rolled tubes