NEXT-100 Pressure Vessel, May 7, 2012

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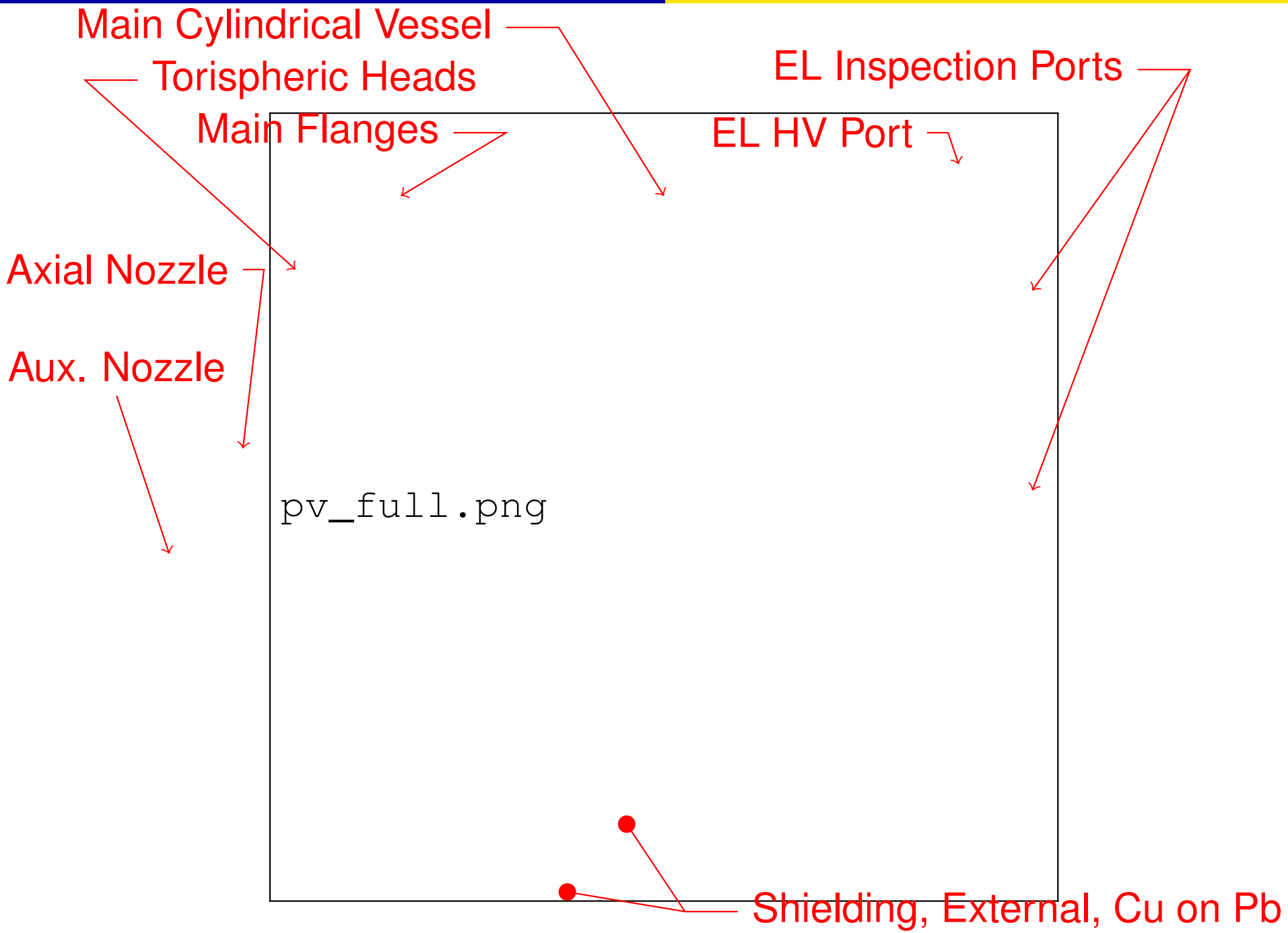
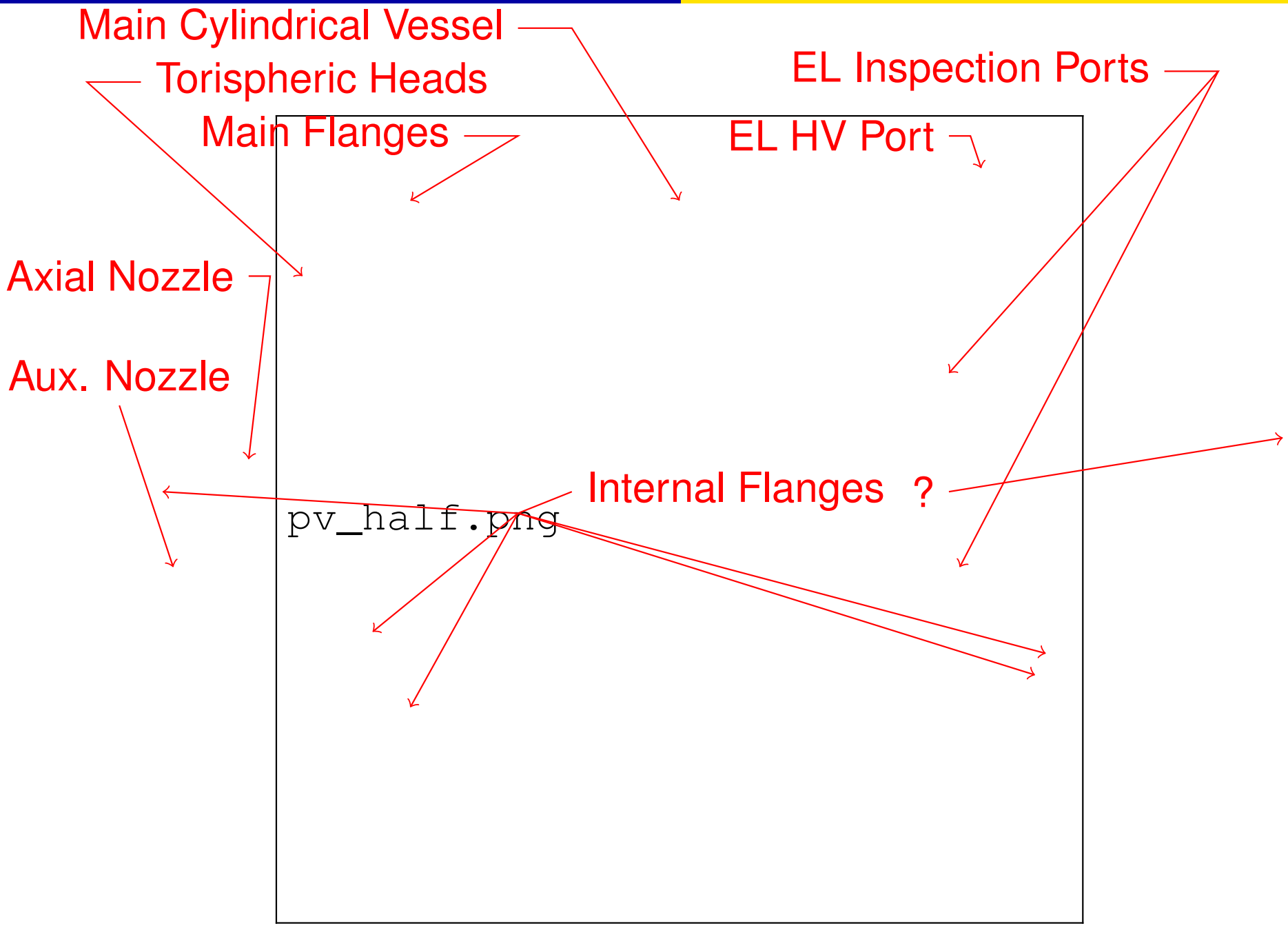
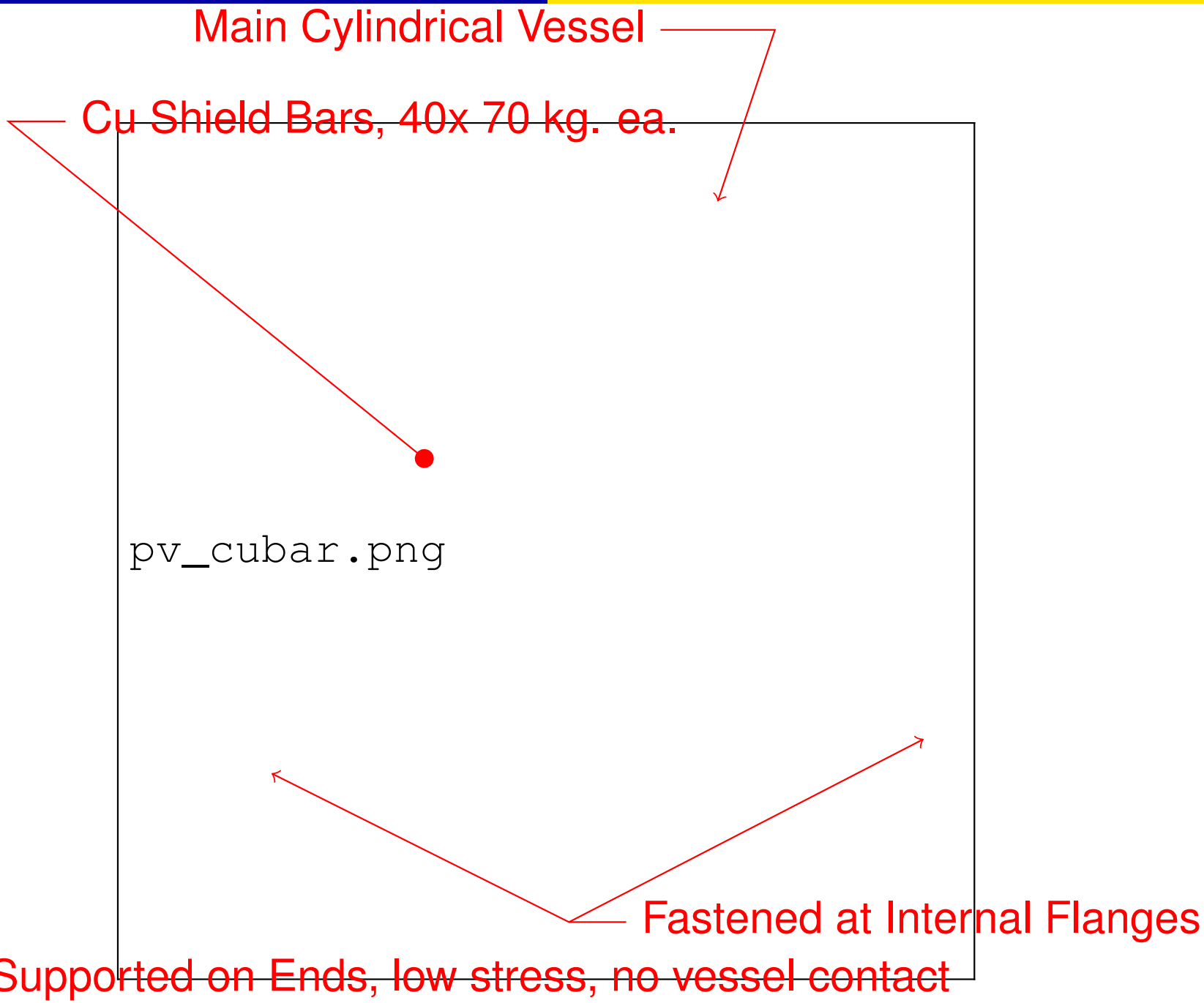
- Vessel design simplified.
  - 3 parts instead of 4 - no service plate
  - plain torispheric heads, both ends, PMTs inside
- Vessel axis changed from vertical to horizontal
  - reduces shielding height
  - gives room for axial expansion (cabling)
  - cables and feedthroughs all above work platform
- Vessel material changed to stainless steel, from titanium
  - Not confident radiopure Ti available
  - Even so, not confident vessel kept clean throughout mfr.
  - High cost of Ti fab - limited mfrs, schedule risk
  - Stainless (304, 316) available in the few mBq/kg range, SO:
- A copper liner (6 cm thk.) has been added to shield the higher background stainless steel

Parameter, (53 cm radius x 130 cm active vol.)	qty	units
Maximum Operating Pressure (MOP)	15.0	bar (abs)
Maximum Allowable Working pressure (MAWP)	16.4	bar (abs)
Minimum Allowable Pressure (external	1.5	bar (abs)
Inner diameter	124	cm
Outer Diameter, Vessel	126	cm
Outer Diameter, Flanges	134	cm
Length, inside shielding	2.22	m
Length, end to end, axial	2.85	m
Vessel and head wall thickness	10	mm
Flange thickness, head to vessel (both)	3.0	cm
Bolt Diameter (Inconel 718), head to vessel flanges	14	mm
Bolt length, head to vessel flanges	9	cm
Number of Bolts, each head to vessel flange	120	
Mass, Vessel and both heads	1100	kg
Mass, Internal copper shielding (6 cm)	4700	kg

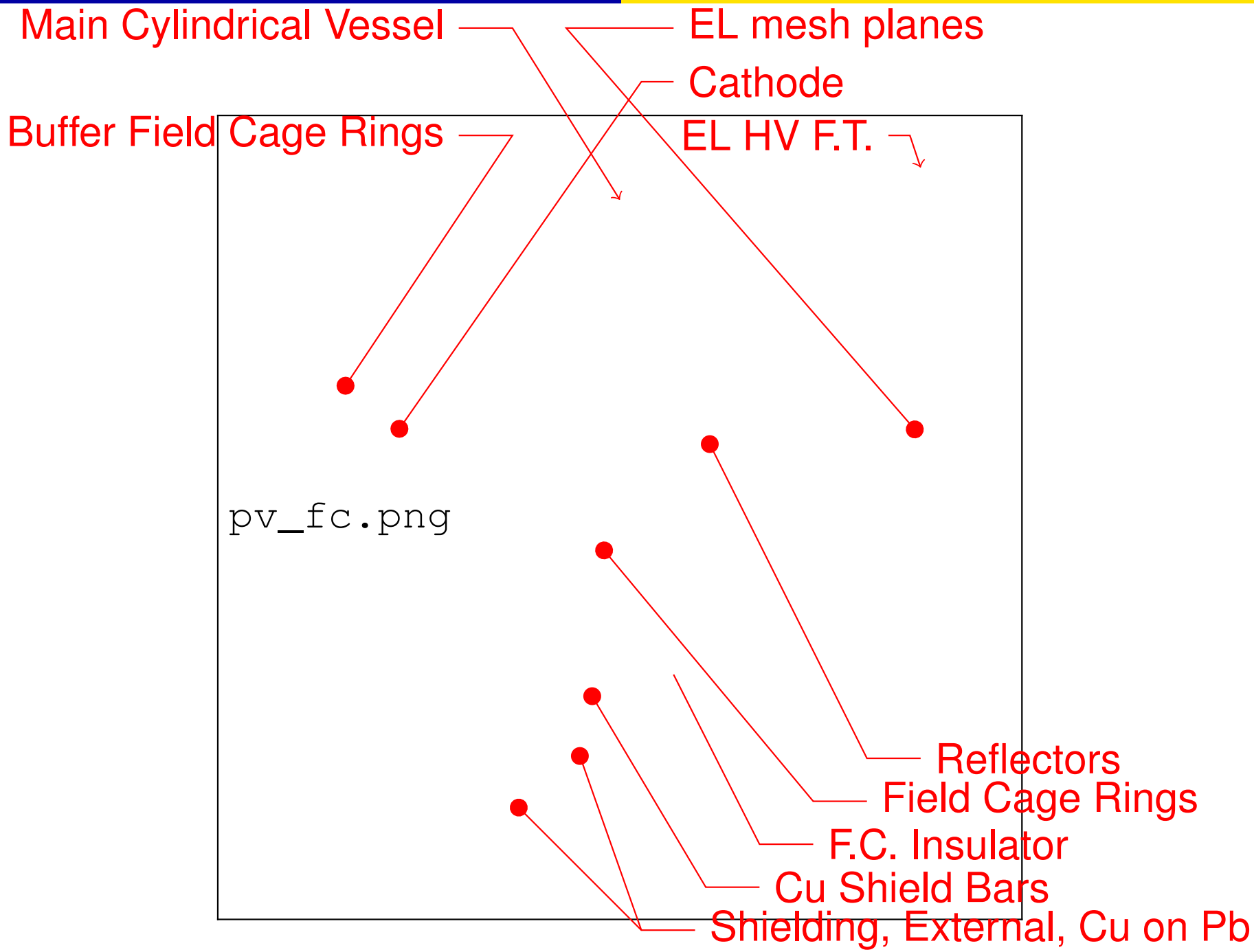

Main Cylindrical Vessel
Torispheric Heads
Main Flanges
EL Inspection Ports
EL HV Port
Axial Nozzle
Aux. Nozzle
pv_full.png
Shielding, External, Cu on Pb

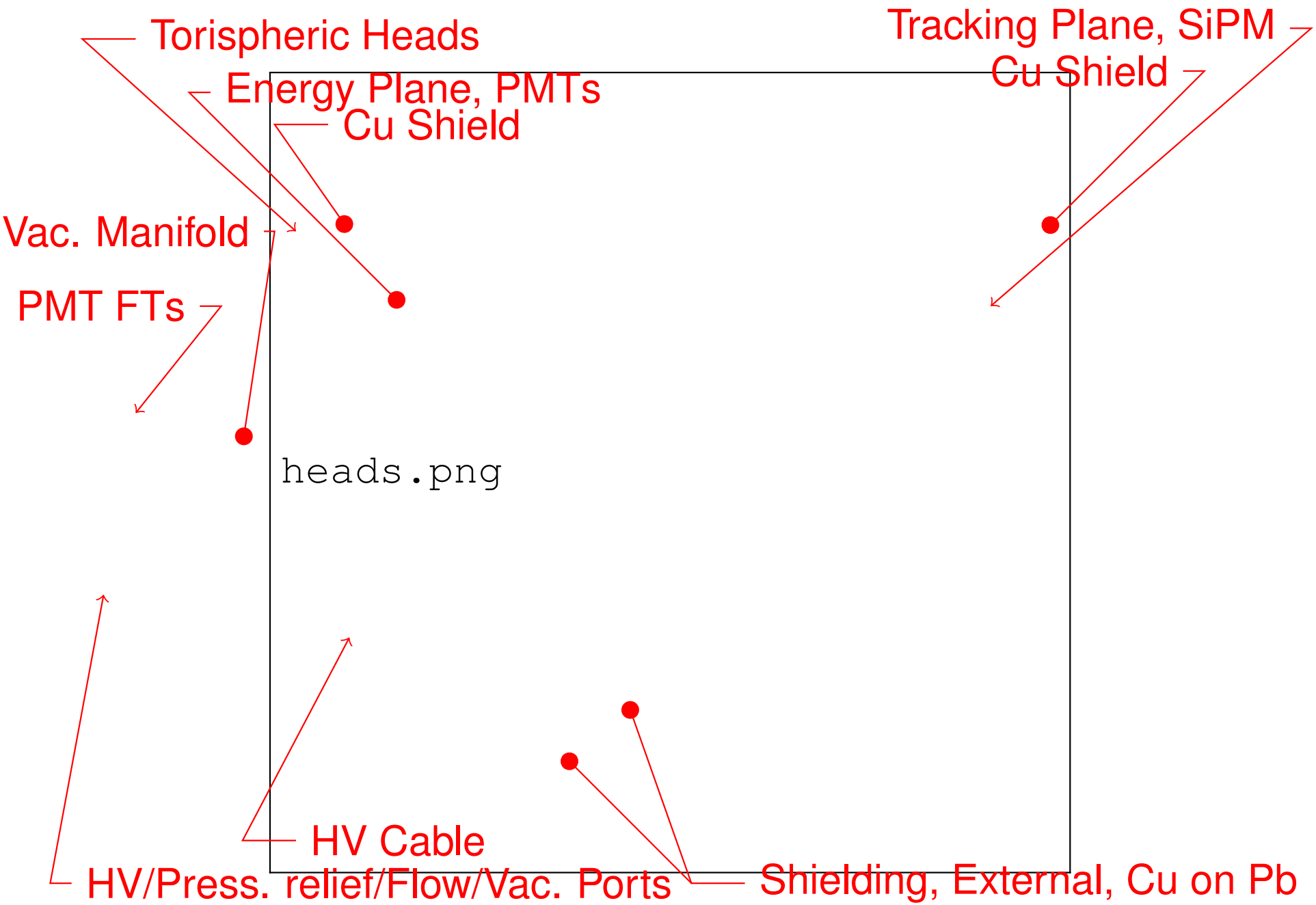

Main Cylindrical Vessel
Torispheric Heads
Main Flanges
EL Inspection Ports
EL HV Port
Axial Nozzle
Aux. Nozzle
Internal Flanges ?
pv_half.png


Main Cylindrical Vessel
Cu Shield Bars, 40x 70 kg. ea.
pv_cubar.png
Fastened at Internal Flanges
Supported on Ends, low stress, no vessel contact

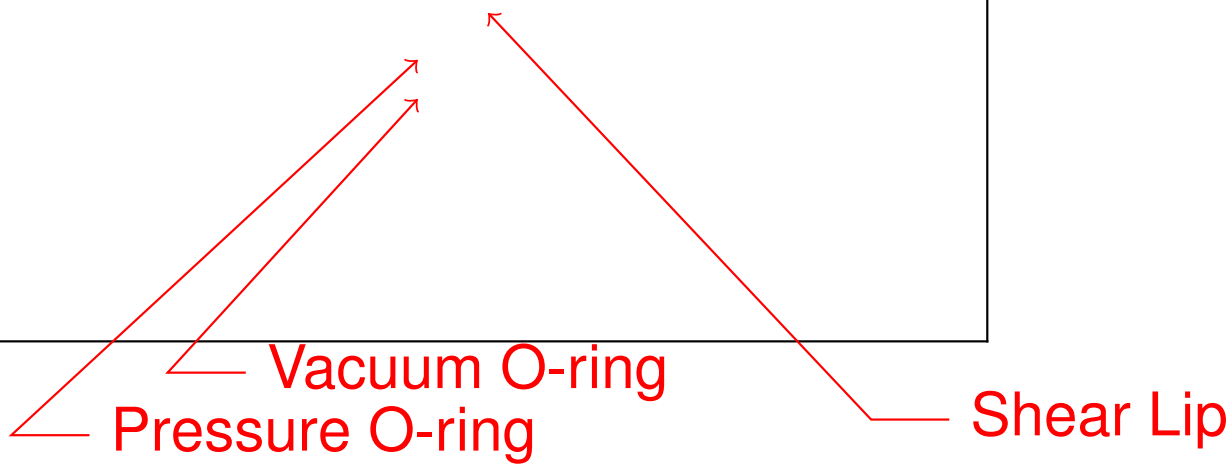
Copper bars fastened to main cylindrical vessel internal flange

cubar_end1.pdf

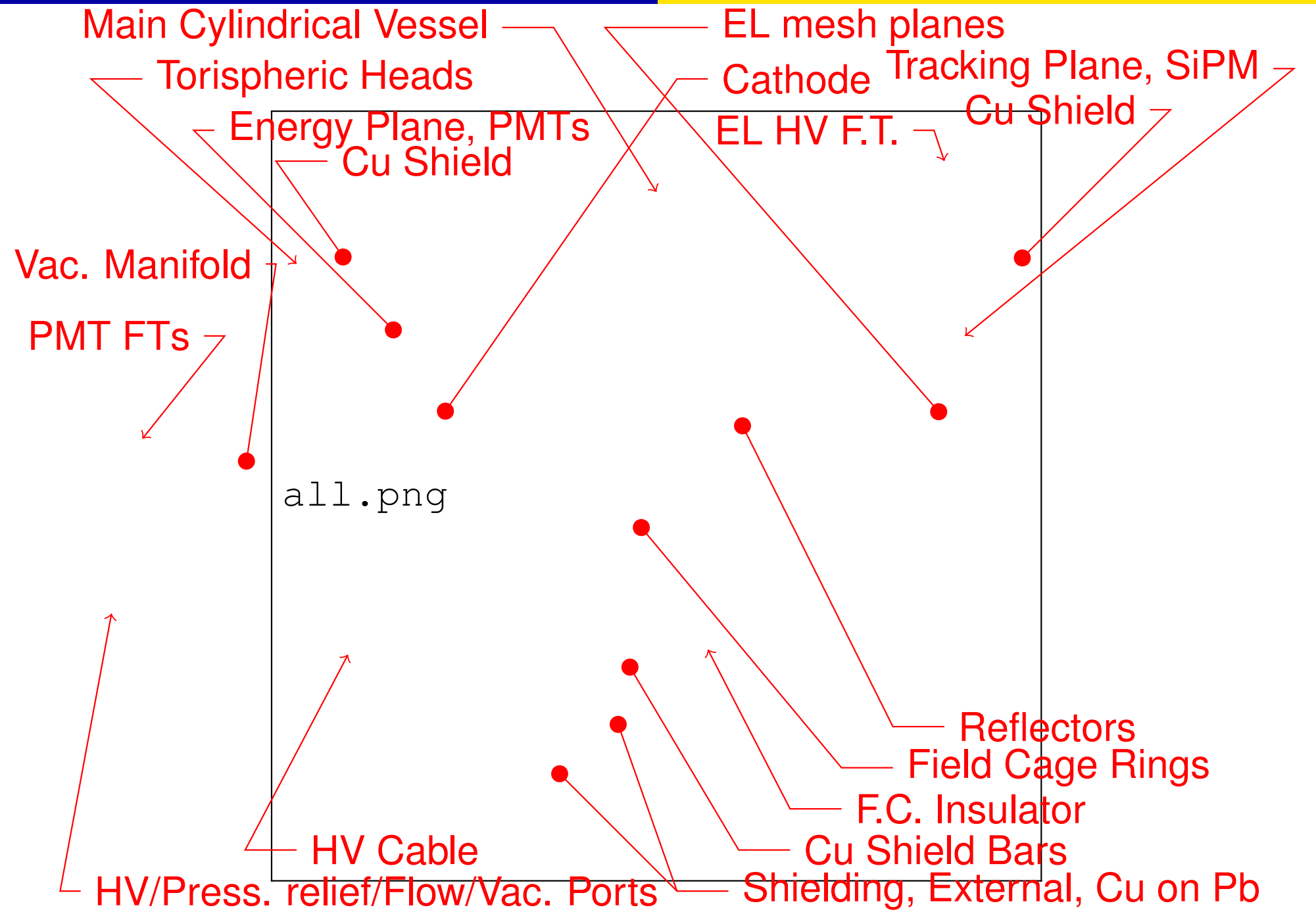

Main Cylindrical Vessel
EL mesh planes
Cathode
Buffer Field Cage Rings
EL HV F.T.
pv_fc.png
Reflectors
Field Cage Rings
F.C. Insulator
Cu Shield Bars
Shielding, External, Cu on Pb


Torispheric Heads
Energy Plane, PMTs
Cu Shield
Tracking Plane, SiPM
Cu Shield
Vac. Manifold
PMT FTs
heads.png
HV Cable
HV/Press. relief/Flow/Vac. Ports
Shielding, External, Cu on Pb

ehead_cu_hv.png



Estimated leakage <200 gm/year (butyl, nitrile O-rings) -recover in cold trap


Main Cylindrical Vessel
Torispheric Heads
Energy Plane, PMTs
Cu Shield
Vac. Manifold
PMT FTs
EL mesh planes
Cathode
EL HV F.T.
Tracking Plane, SiPM
Cu Shield
all.png
Reflectors
Field Cage Rings
F.C. Insulator
Cu Shield Bars
Shielding, External, Cu on Pb
HV Cable
HV/Press. relief/Flow/Vac. Ports

- We write: User Design Specification (UDS).
  - Specifies our specific requirements, size, loads, operation, no. cycles, etc.
  - Does not dictate thicknesses, etc. as mfr. is responsible for pressure integrity
  - We have a draft UDS written - needs drawings added
  - However - We also design vessel fully for our prior knowledge (no surprises)
- User Design Specification to be Certified (by Certifying Authority)
  - Checks for completeness and correctness of UDS
  - Certifying Authority must be ASME certified
  - Certifying person must be Professional Engineer
- Manufacturer writes: Manufacturer's Design Report (MDR)
  - has final dwgs., calculations, material and welder certs, test reports, etc
- Manufacturer's Deign Report to be Certified (by Certifying Authority)
  - Must be certified as correct by Professional Engineer
  - - not same person as for UDR (same firm OK)

- Full audit and inspection rights - in addition to official inspector
- Radiopurity
  - Samples required for all material lots.
  - Adequate time for testing - must coordinate
  - Weld samples (from previously measured clean stock)
  - Strict electrode and gun control - no thoriated allowed
  - ? ceriated, lanthanated, yttriated, zirconium OK?
  - ? Gas quality? (Ar), Electropolish?
- Precision Dimensions
  - Full solution anneal (1050-1120C) at various stages.
  - Careful sequencing of fab steps to be subject to approval
- Leak tightness
  - Plate stock for flanges to be leak checked , end samples, and as-cut rings
  - Full weld radiograph inspection (also minimizes req. thickness)
  - Must pass vac. leak rate check after fab.

- Complete DRAFT UDS - update drawings
- Pass Draft to potential Manufacturers
  - Assess design details for manufacturability
  - Obtain a good cost and schedule estimate
- Pass Draft to potential Certification Authorities
- Complete our Design Analysis (supports, small flanges)
- Fine tune existing features
  - Size Nozzles for HV
  - Verify or modify overall dimensions for Field Cage ?
  - Nozzle and flanges design for Tracking Plane - CM or not?
  - Internal mounting flange dimensions- mfr input