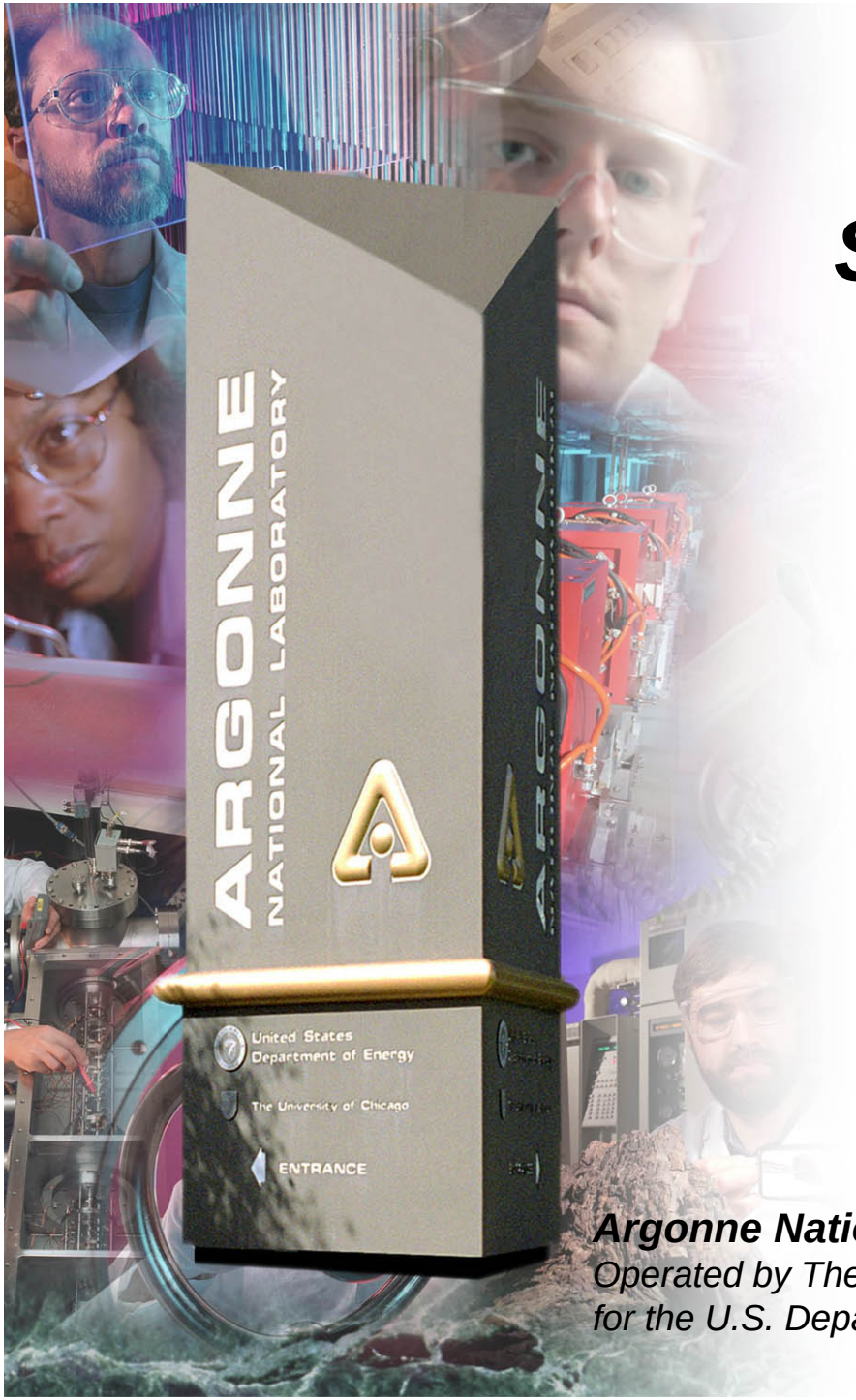


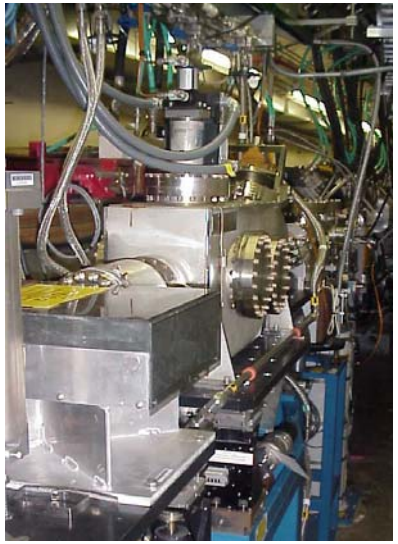
FRONT END SAFETY SHUTTER SPARES

05/03/05

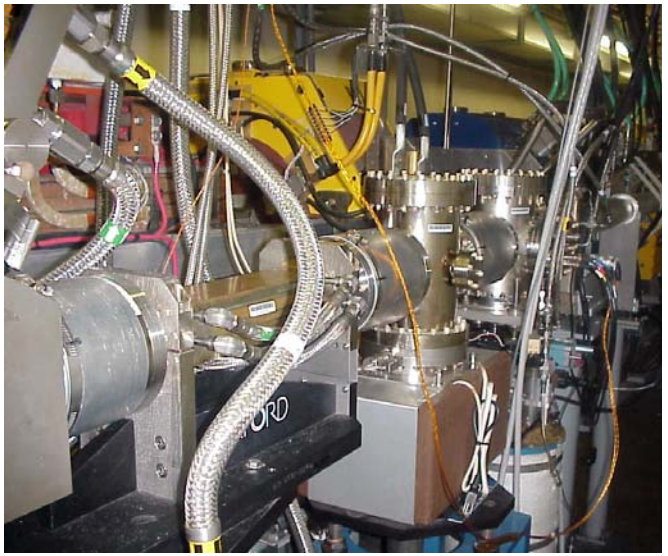
Argonne National Laboratory
Operated by The University of Chicago
for the U.S. Department of Energy

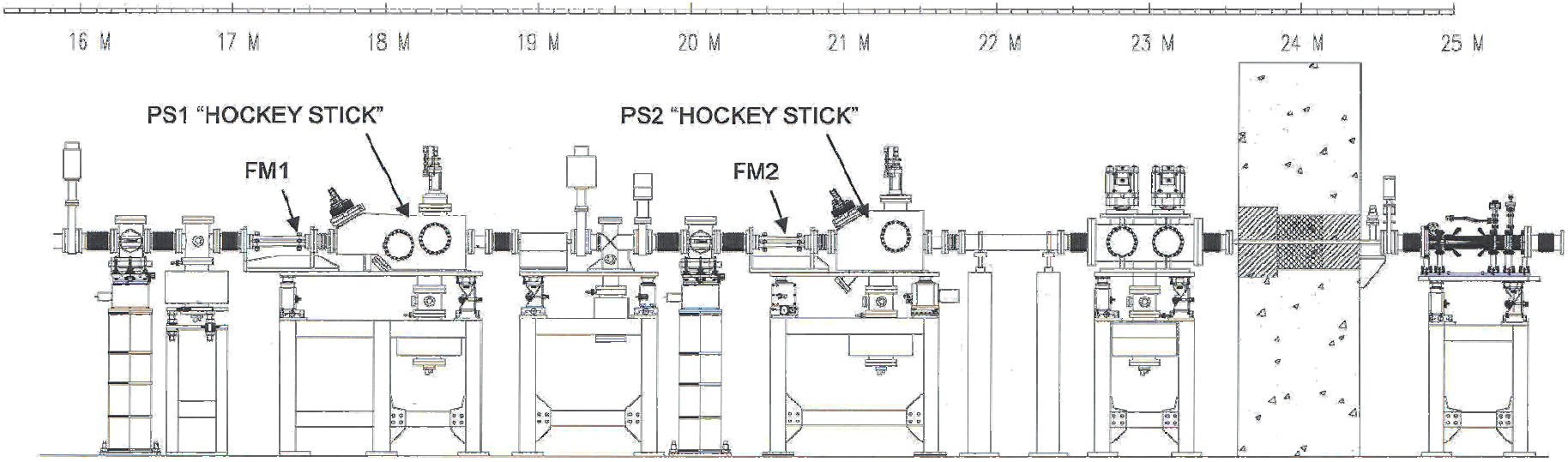
Office of Science
U.S. Department of Energy

Front End Safety Shutter Spares



EXISTING
FRONT END



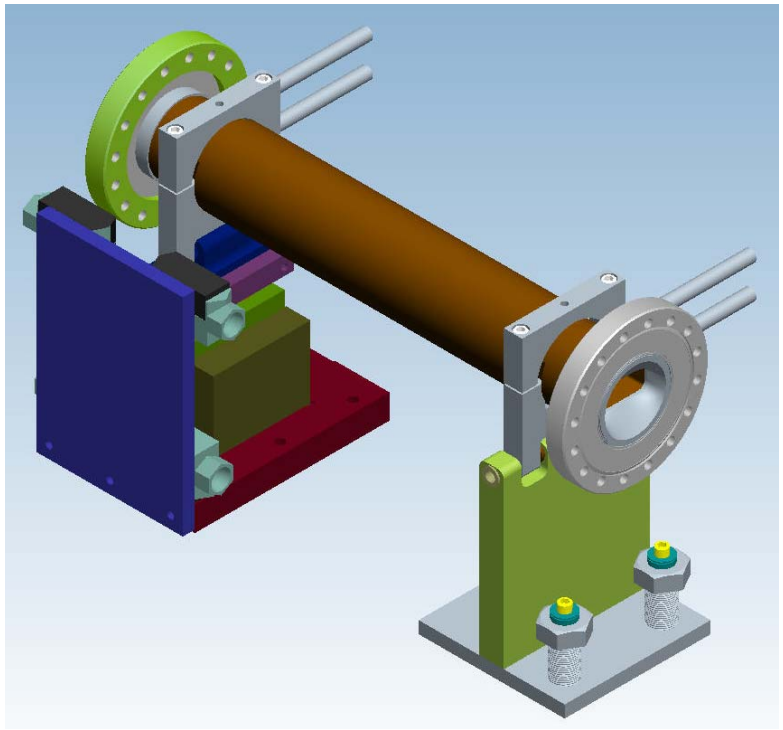


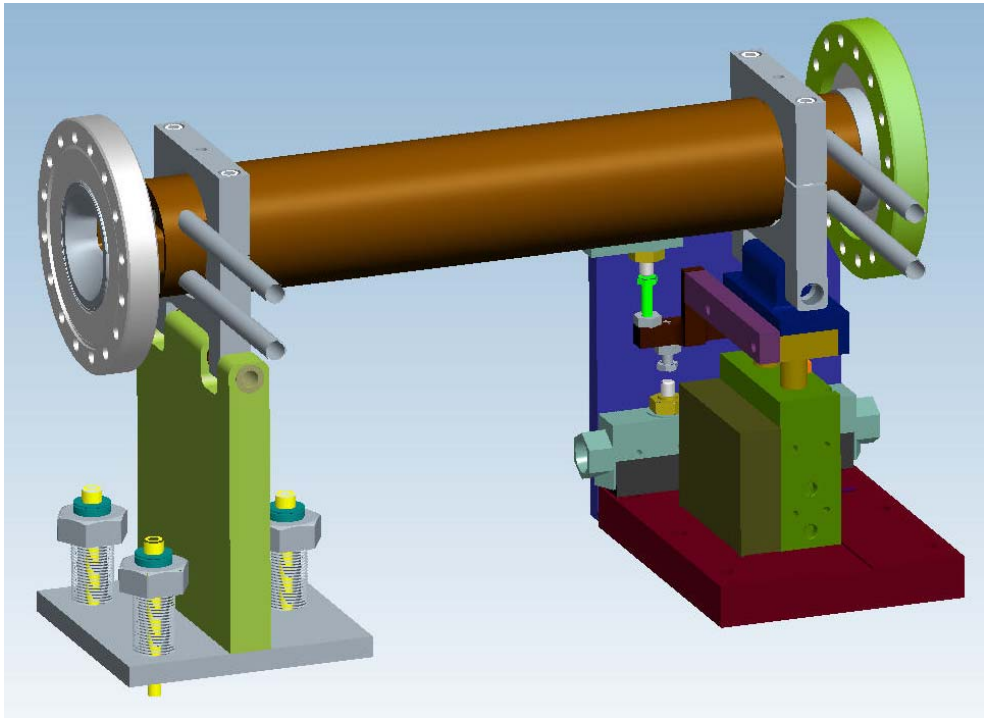
EXISTING V1.2 ID FE

Front End Safety Shutter Spares

NEW SAFETY SHUTTER PROPOSAL

- **SINGLE BODY DESIGN SIMPLIFIES FABRICATION**
- **SMC – DUAL CYLINDER AIR CYLINDER**
- **REDUNDENT SAFETY SWITCHES AS WELL AS POSITION SWITCHES ON THE CYLINDER**
- **SIMPLIFIED SUPPORT FOR COST EFFECTIVE FABRICATION**
- **ROTATABLE FLANGES ON BOTH ENDS**

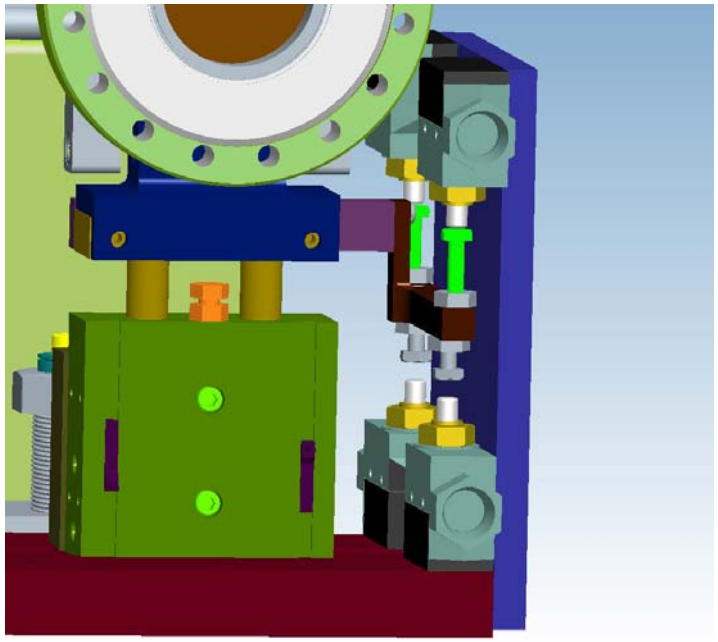


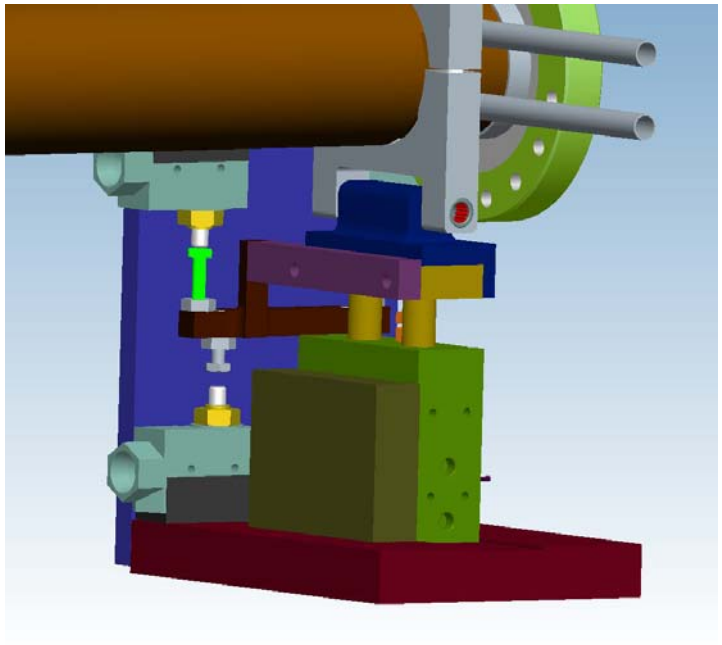


Front End Safety Shutter Spares

NEW SAFETY SHUTTER PROPOSAL

- **SMC – DUAL CYLINDER AIR CYLINDER**
  - **BUILT IN ANTI-ROTATION**
  - **BUILT IN ADJUSTABLE HARD STOPS FOR STROKE**
- **T-SHAPPED SAFETY SWITCH STRIKER TO ASSURE CONSTANT REDUNDANT SWITCH CONTACT**



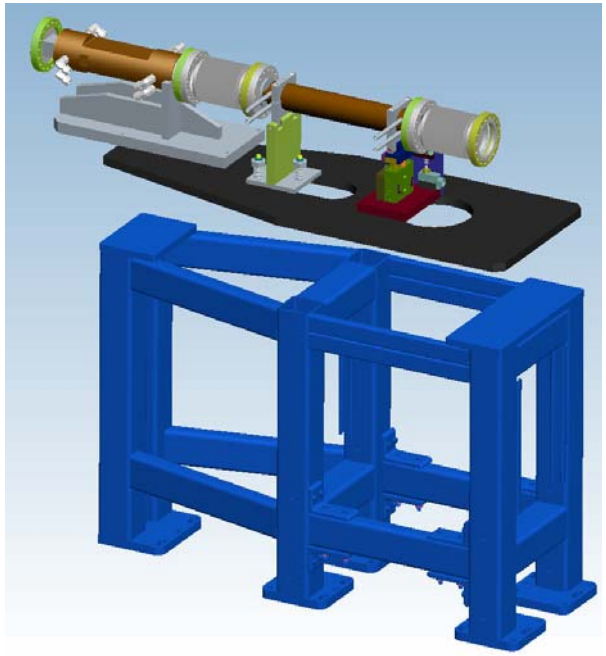


Front End Safety Shutter Spares

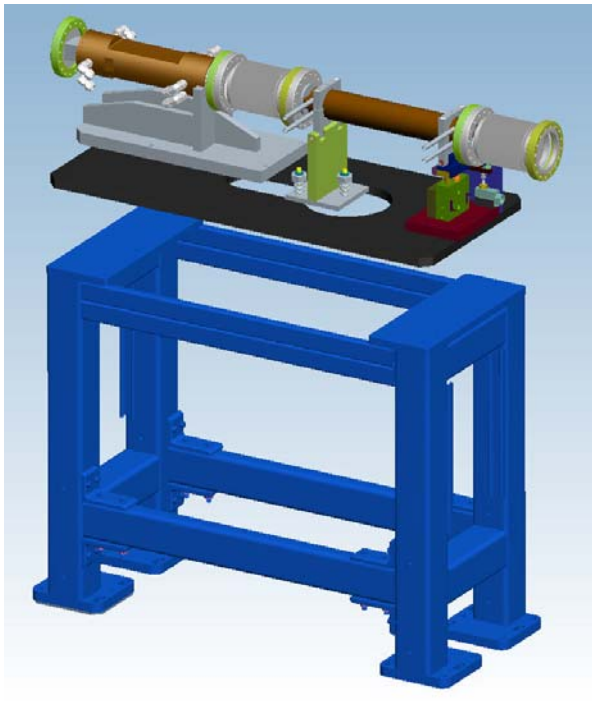
INSTALLATION PROPOSAL

- **EXISTING TABLES WILL BE UTILIZED**
- **EXISTING MASKS WILL BE KEPT**
- **EXISTING MASK SUPPORTS CAN BE USED OR REPLACED FOR A MORE ADJUSTABLE DESIGN IF REQUIRED**

- **IDENTICAL SHUTTERS WILL BE USED AT BOTH PS-1 & PS-2**



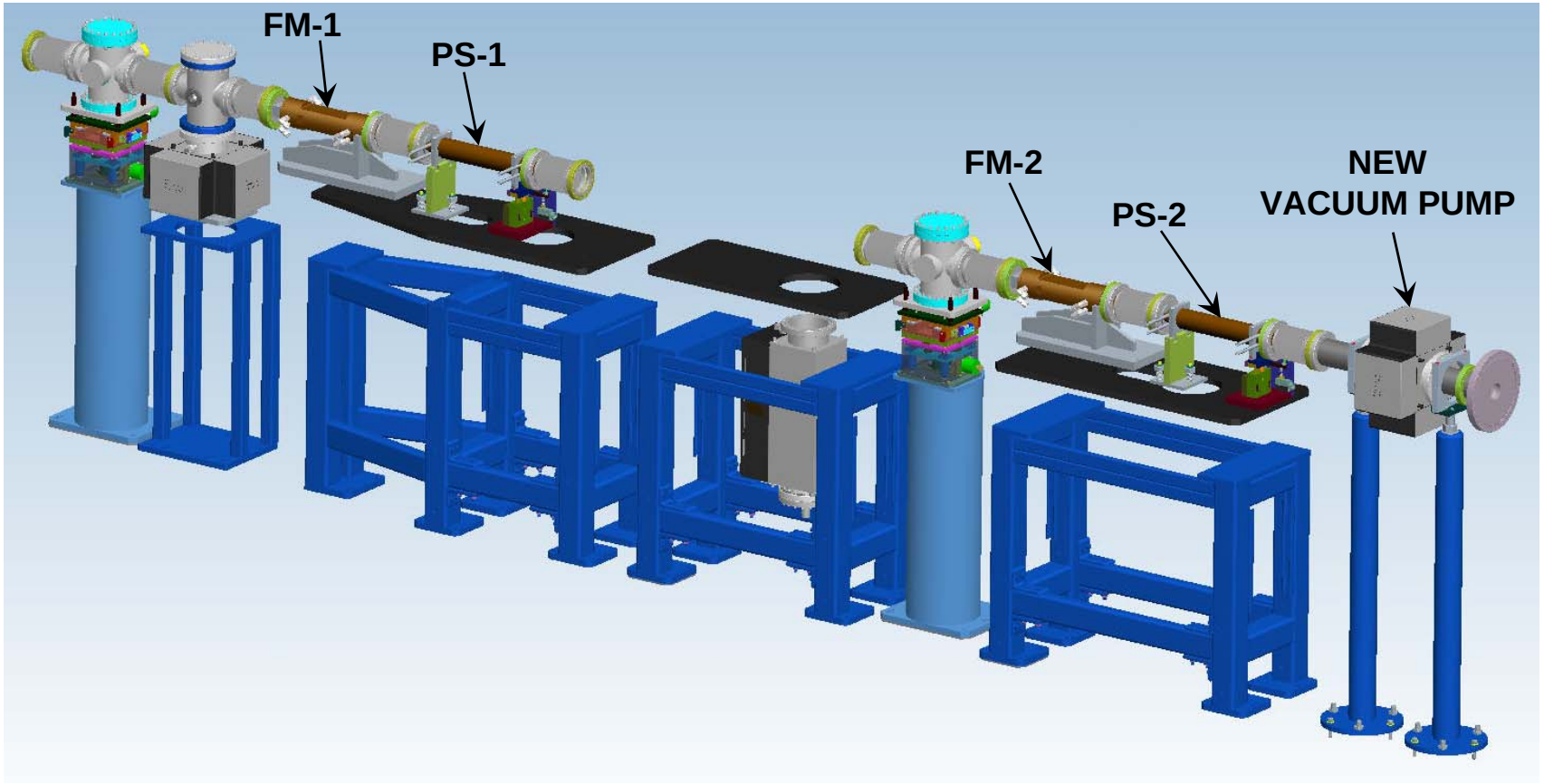
PS-1 SHUTTER



PS-2 SHUTTER

Front End Safety Shutter Spares

NEW PROPOSED FRONT END LAYOUT



Front End Safety Shutter Spares

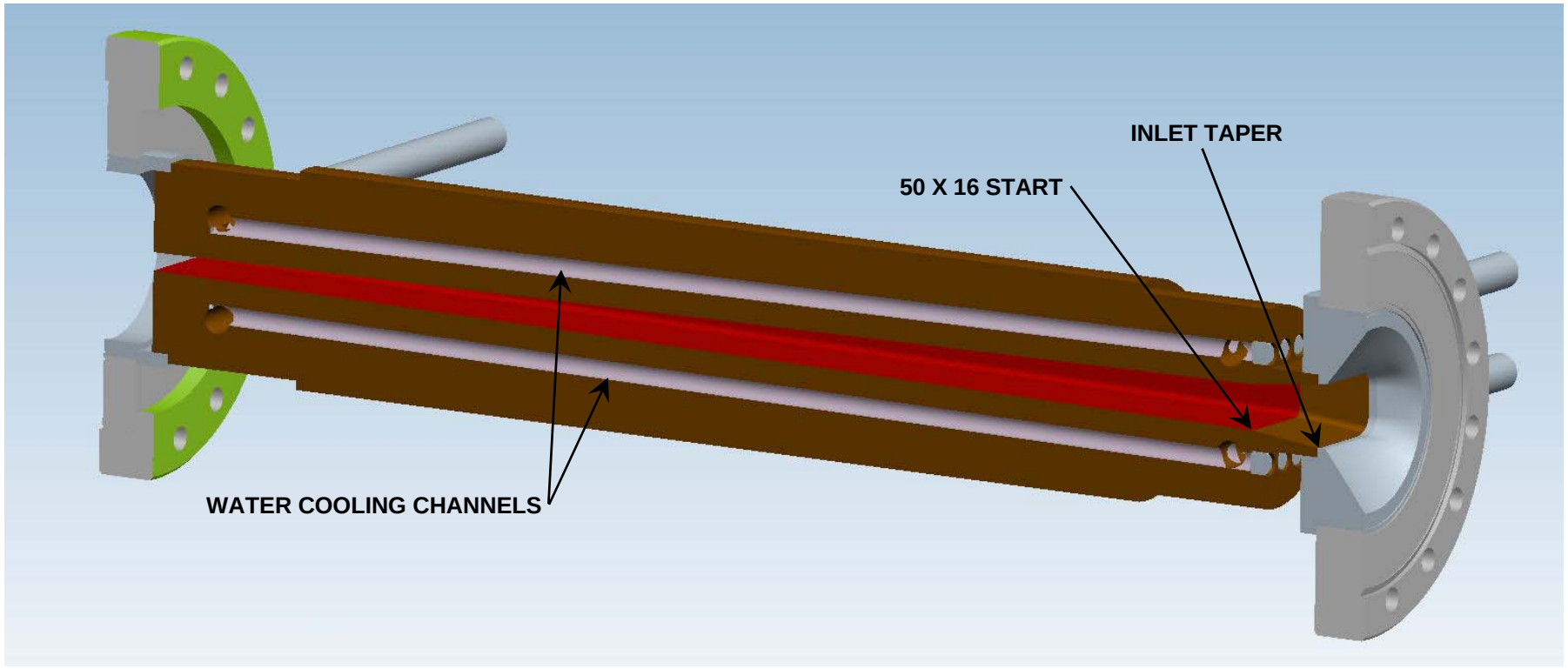
NEW PROPOSED FRONT END APERATURE

	EXISTING				PROPOSED			
	LOCATION (m)	INLET [H x V] (mm x mm)	OUTLET [H x V] (mm x mm)	TAPER ANGLE	LOCATION (m)	INLET [H x V] (mm x mm)	OUTLET [H x V] (mm x mm)	TAPER ANGLE
FM1	17.3	38 x 26	24 x 12	1.5° H 1.5° V	17.3	38 x 26 UNCHANGED	24 x 12 UNCHANGED	1.5° H 1.5° V UNCHANGED
PS1	17.9	N/A	70 x 16	1.5°	17.9	50 x 16	50 x 6	0.63° OPEN 1.75° CLOSED
FM2	20.6	66 x 18	54 x 6	1.5° H 1.5° V	20.6	66 x 18 UNCHANGED	54 x 6 UNCHANGED	1.5° H 1.5° V UNCHANGED
PS2	21.2	N/A	70 x 10	2.0°	21.2	50 x 16	50 x 6	0.63° OPEN 1.75° CLOSED

Front End Safety Shutter Spares

SHUTTER DESIGN PARAMETERS

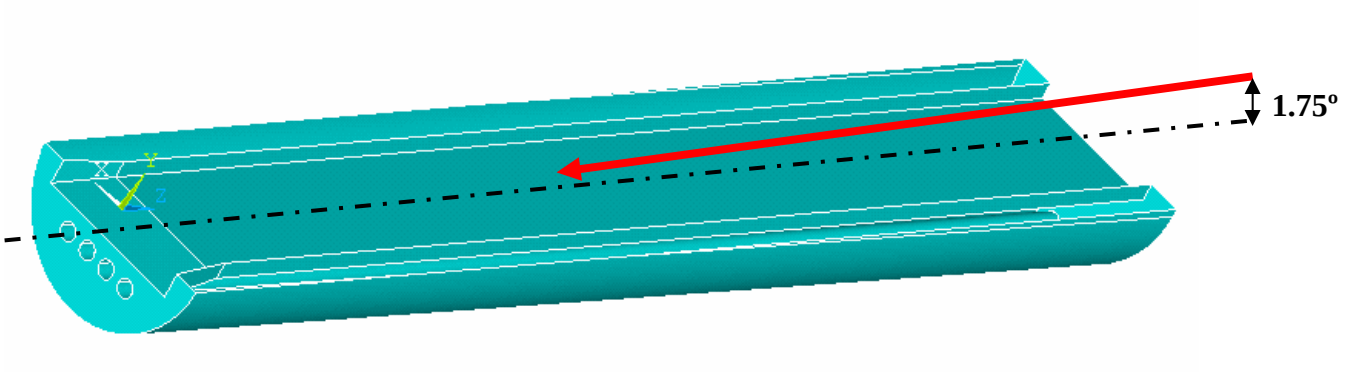
- 50 x 16 INLET
- 50 x 6 OUTLET
- 4 COOLING CHANNELS ON EACH CONTACT SURFACE (8) TOTAL
- 3” DIAMETER GLIDCOP BAR
- BEAM CONTACT ANGLE
  - .63° OPEN ANGLE
  - 1.75° CLOSED ANGLE
- 500mm TOTAL LENGTH
- TOTAL ACTUATOR MOVEMENT 7mm

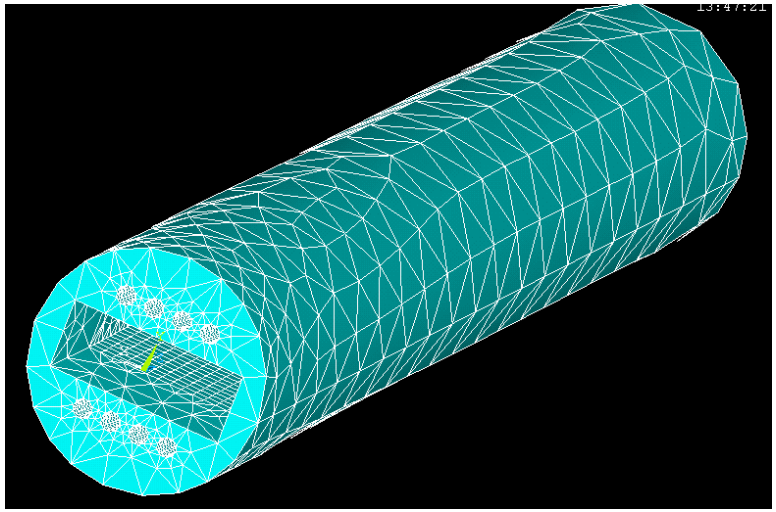


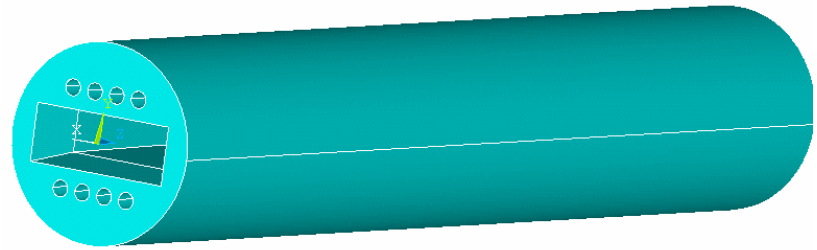
Front End Safety Shutter Spares

FEA ANALYSIS

FEA MODEL UTILIZED







Front End Safety Shutter Spares

FEA ANALYSIS

Case I

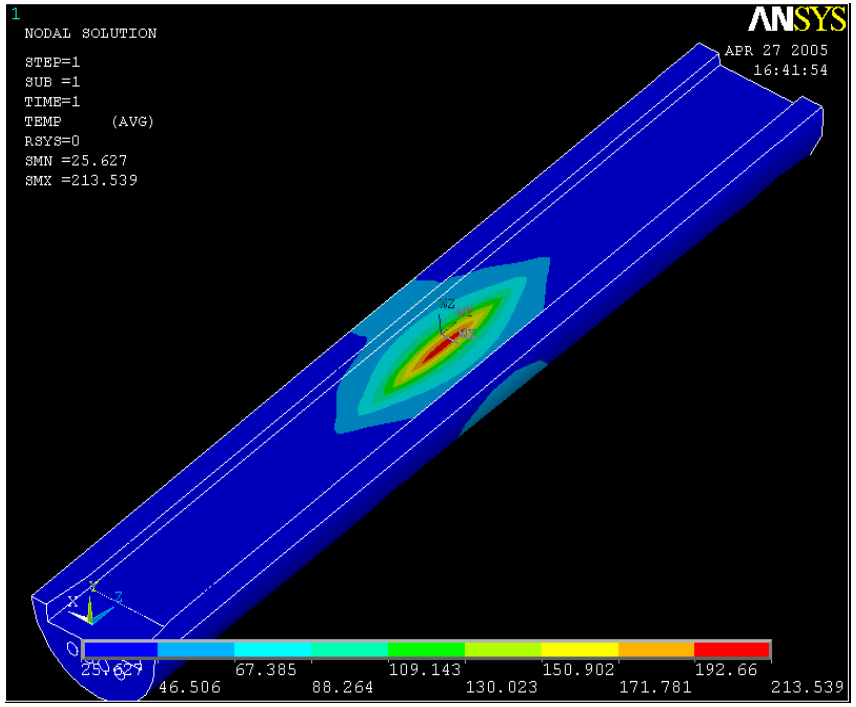


Figure 1. Contour plot for temperature distribution

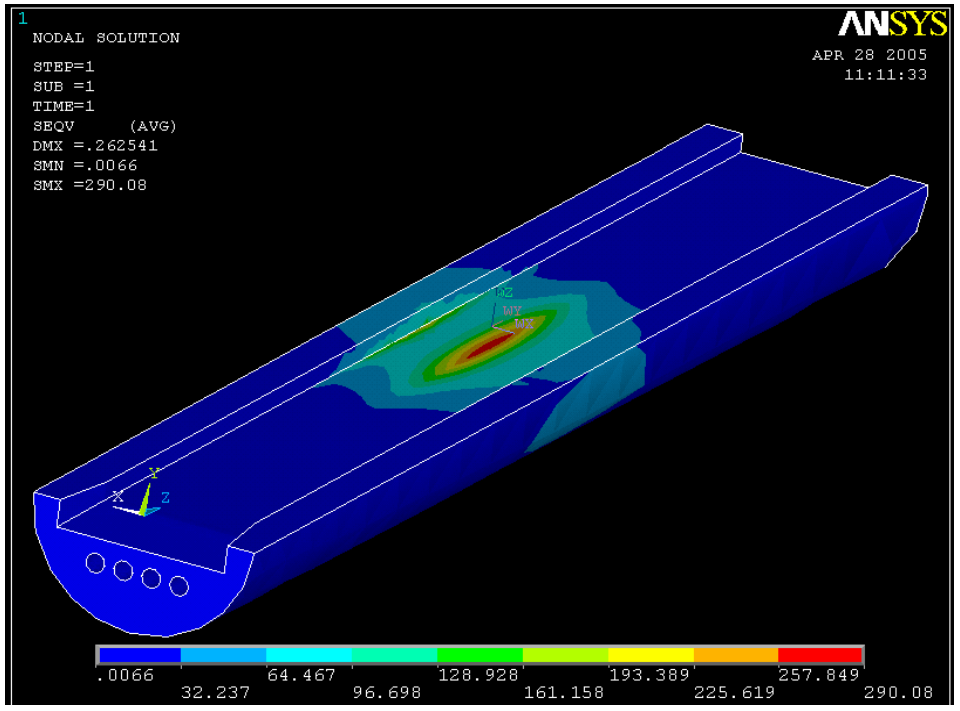


Figure 2. Contour plot for von Mises stress distribution

Front End Safety Shutter Spares

FEA ANALYSIS

Case II

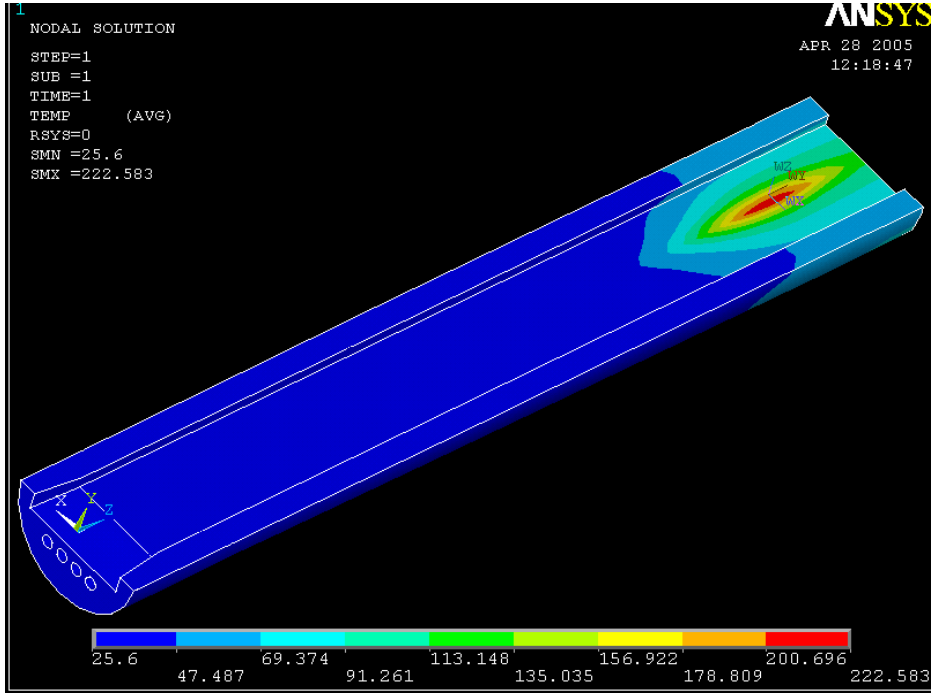


Figure 3. Contour plot for temperature distribution

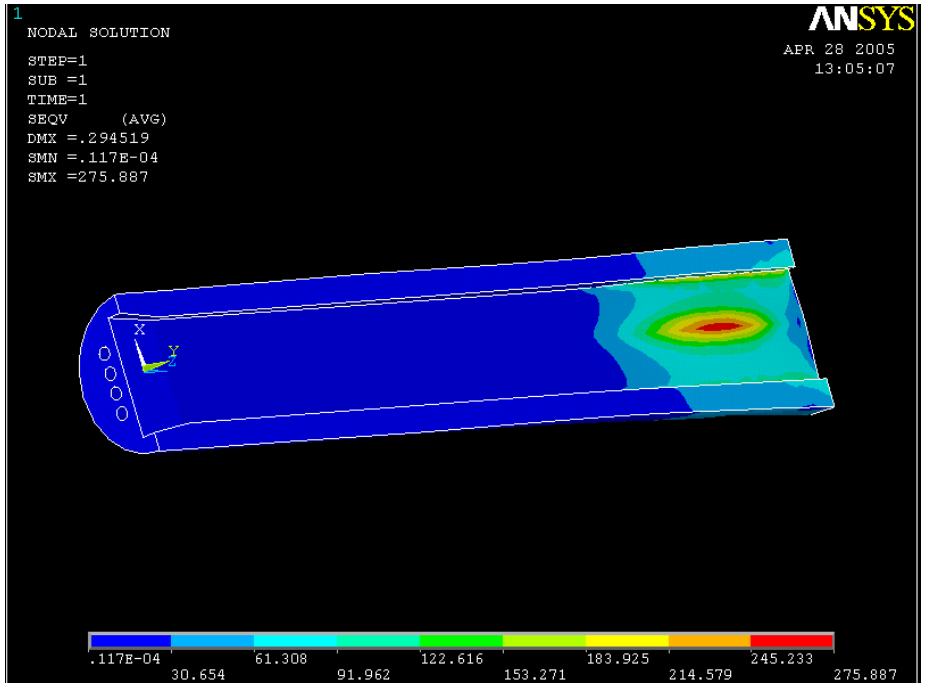


Figure 4. Contour plot for temperature distribution

Front End Safety Shutter Spares

Table 1. FEA results for l5-83 shutter

Result	Case I	Case II
Maximum temperature (º C)	213	222
Cooling wall temperature (º C)	97	97
Maximum von Mises stress (MPa)	290	275

Table 2. Parameters used for FEA

Parameter	Value
Thermal conductivity (w/mm º C)	0.365
Cooling channel film coefficient ($W/mm^{2o}C$)	0.0125
Coefficient of thermal expansion(µm/m)	16.6
Young's Modulus (GPa)	130
Poisson's ratio	0.326
Yield strength (MPa)	331-455
Tensile strength (MPa)	413-483

Table 3. Parameters for undulator power density calculations

Parameters	Value
Distance from source (m)	20
Beam current (mA)	100
Undulator period length ƛ(cm)	3.3
Length of Undulator (m)	2.4
Minimum gap (mm)	11
Relativistic gamma	13700
Number of periods	72
Deflection parameter K	2.62
Beam size (mm): (sigx)	0.352
Beam size (mm): (sigy)	0.018
Total Power (W)	5252 (full power)

Front End Safety Shutter Spares

COST ESTIMATE

BASED ON GLIDCOP TEST STATION SHUTTER DATA

• ABSORBER FABRICATION	$ 6,000
• ABSORBER WELDING AND BRAZING	$ 1,700
• SUPPORT FABRICATION	$ 5,000
• REQUIRED HARDWARE	$ 700
• TOTAL ESTIMATE	$ 13,400

- ITEMS NOT INCLUDED TO DATE
  - REPLACEMENT BELLOWS
  - ACTUATOR
  - VACUUM PUMP AFTER PS-2 SUPPORT MODIFICATION