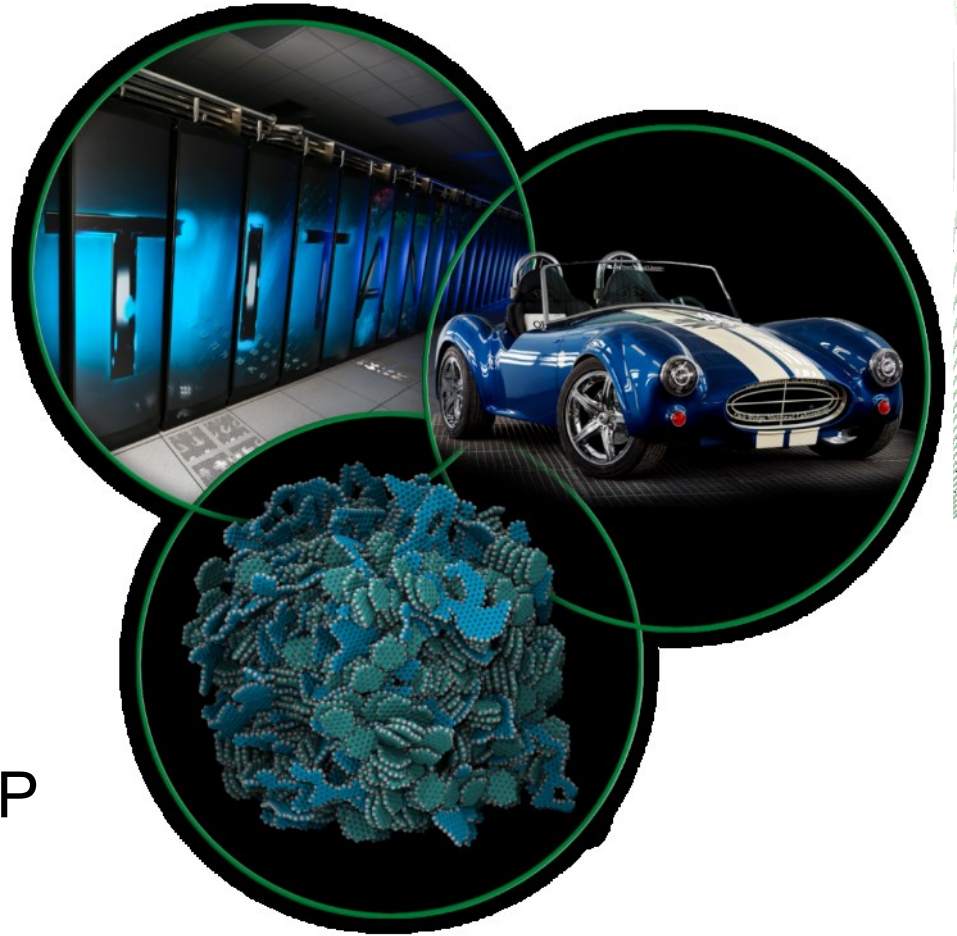


Planning and Execution of Radiological Work for Spallation Neutron Source Inner Reflector Plug Changeout

Christi L. Elam, RSO
Scott O. Schwahn, Ph.D., CHP
Nate D. Foster, RRPT
George M. Stephens, CHP
Scott A. Byers, CHP



Overview

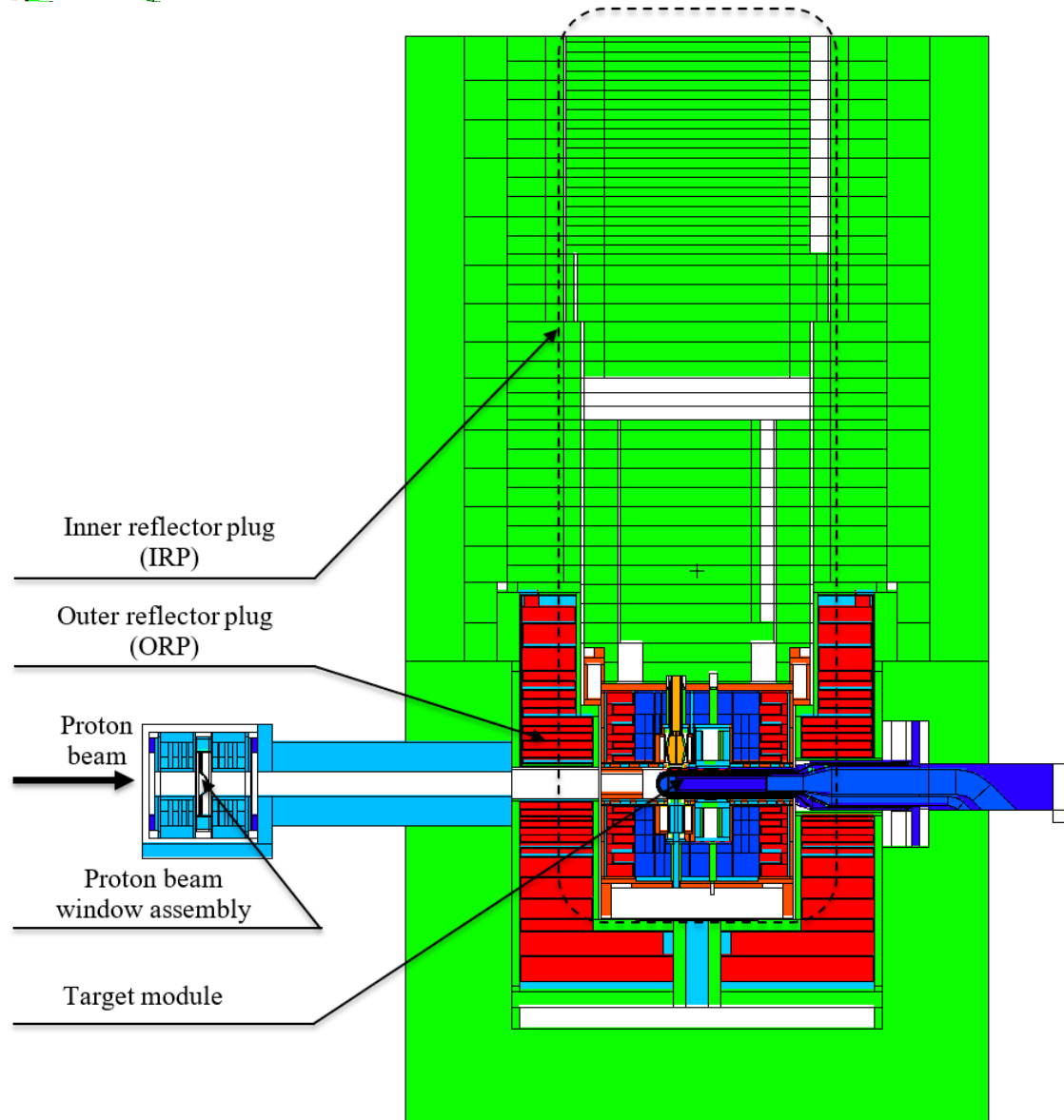


Figure 1. Vertical cross section through the beam central line of the target station model

Overview

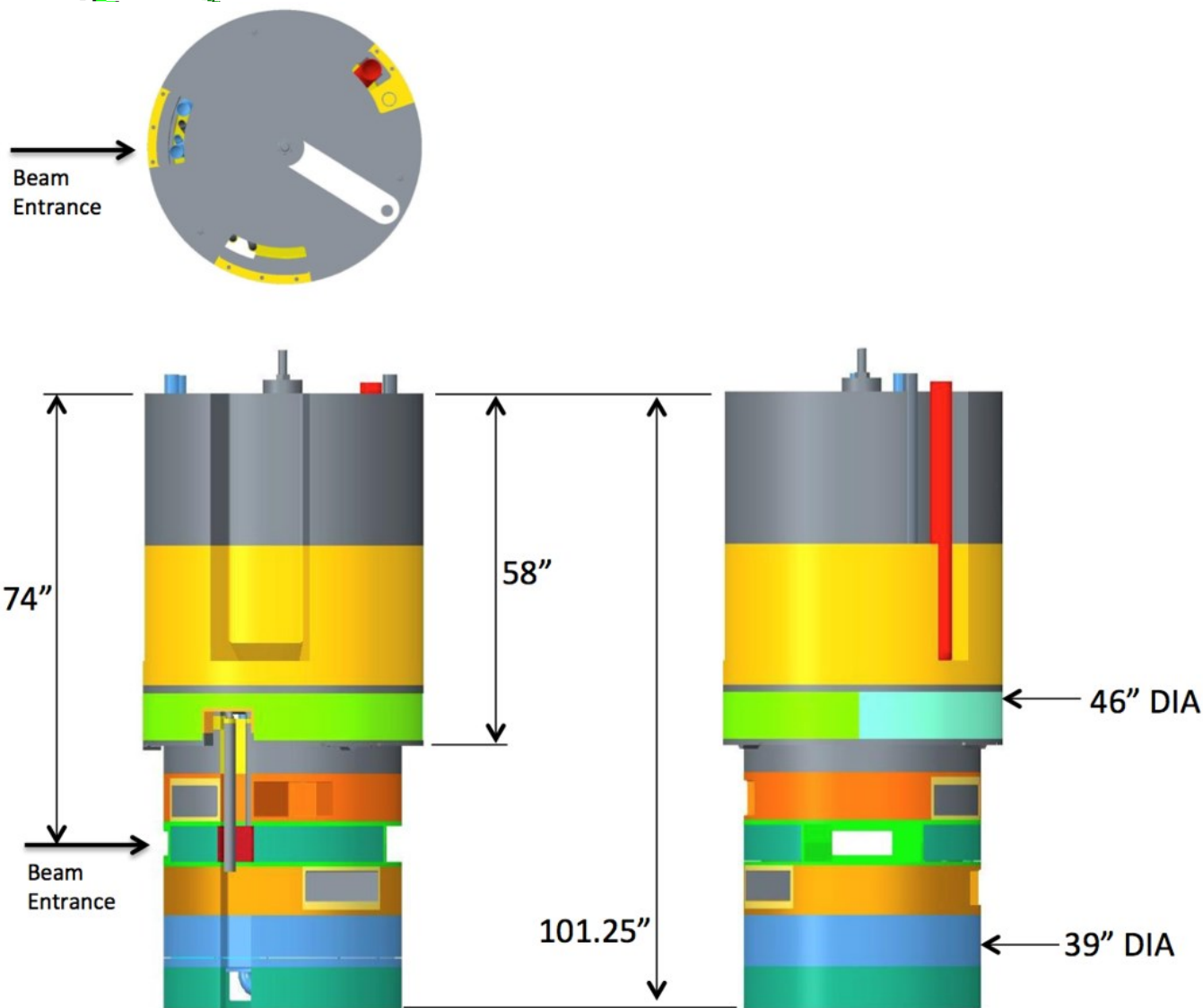


Figure 2. IRP top section with the dimensions

Overview

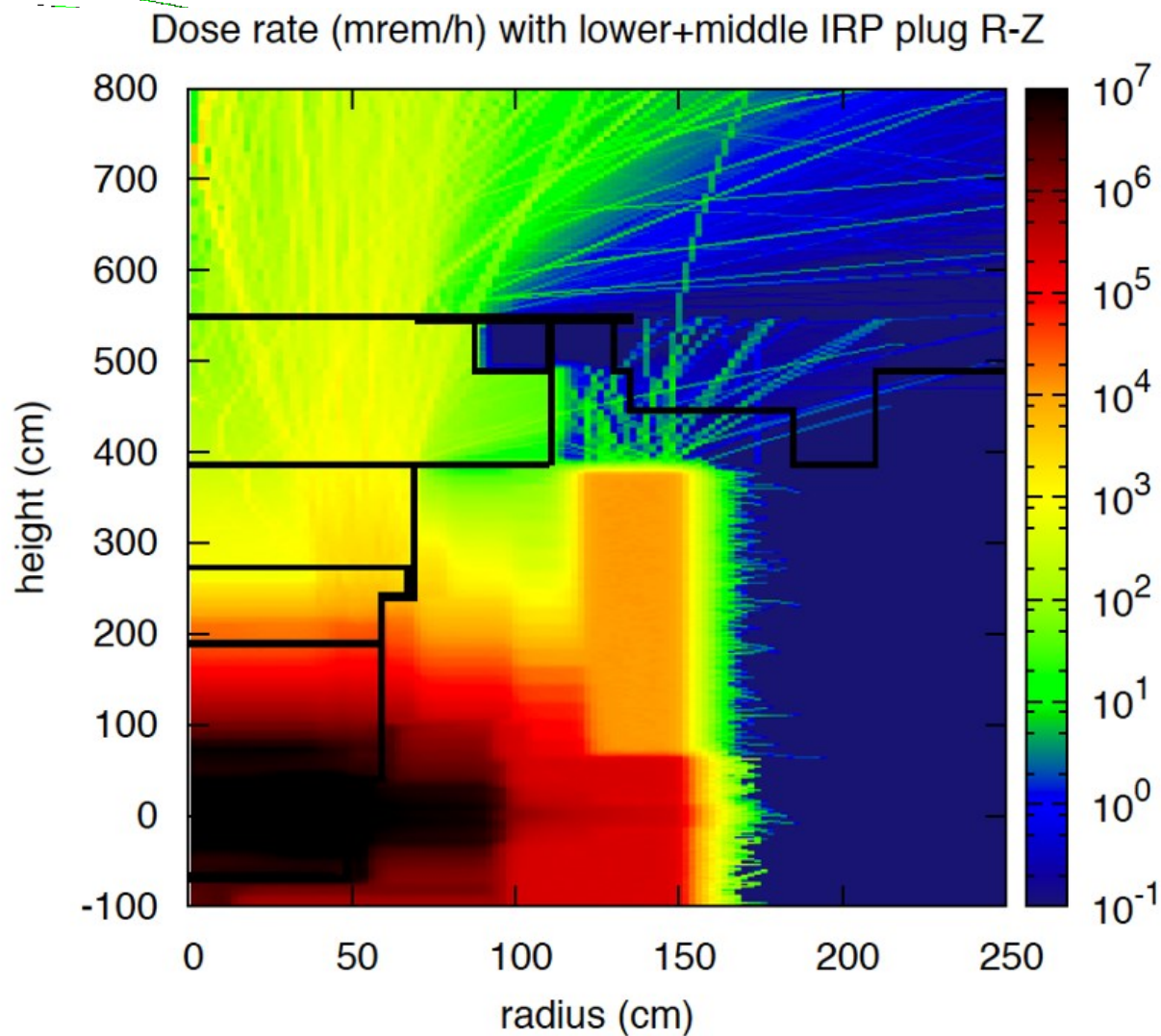


Figure 10: Vertical dose rate map for IRP top shield section removed and the lower and middle IRP sections still inserted.

Overview

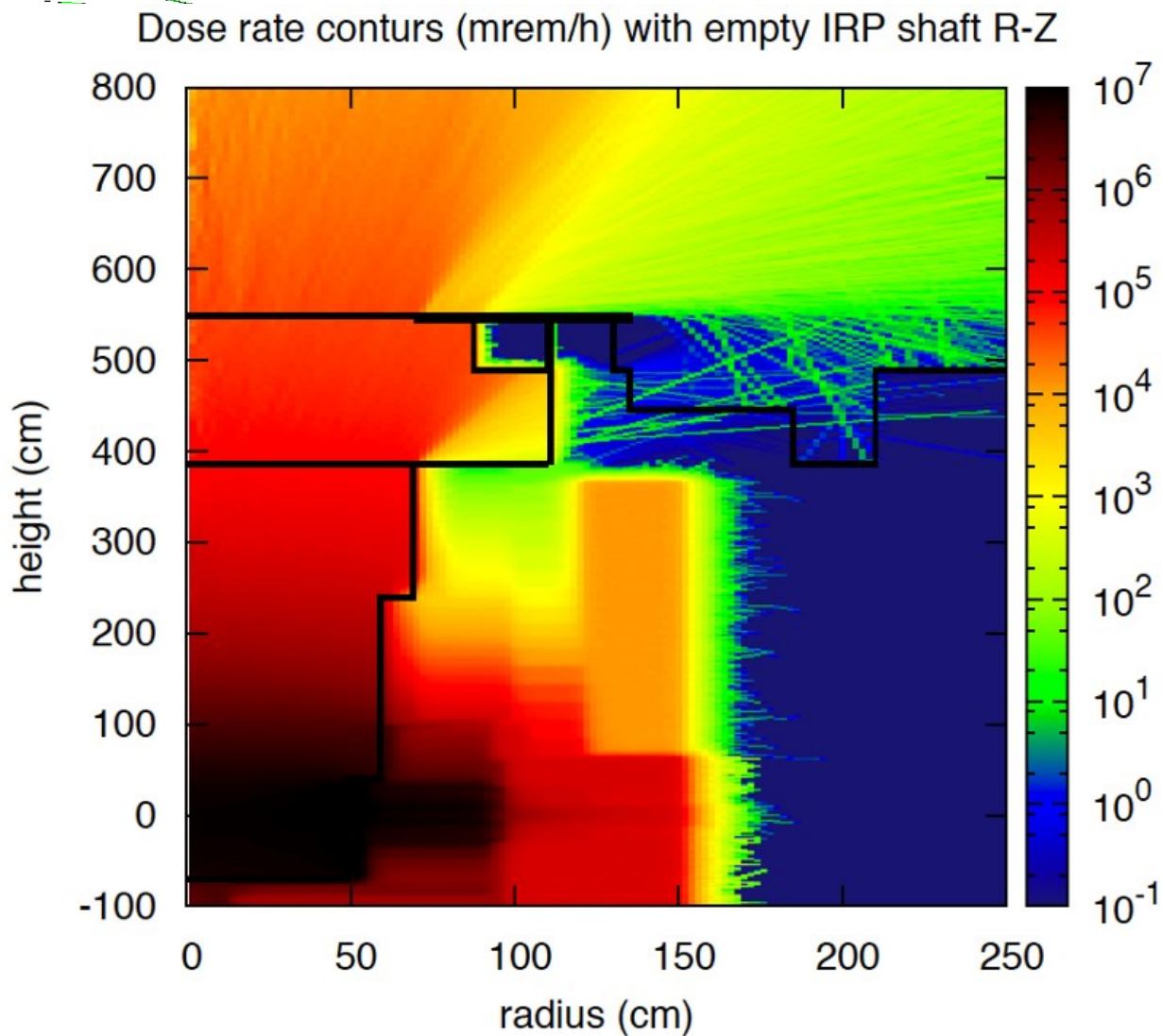


Figure 19: Vertical dose rate map for emptied IRP shaft.

Overview

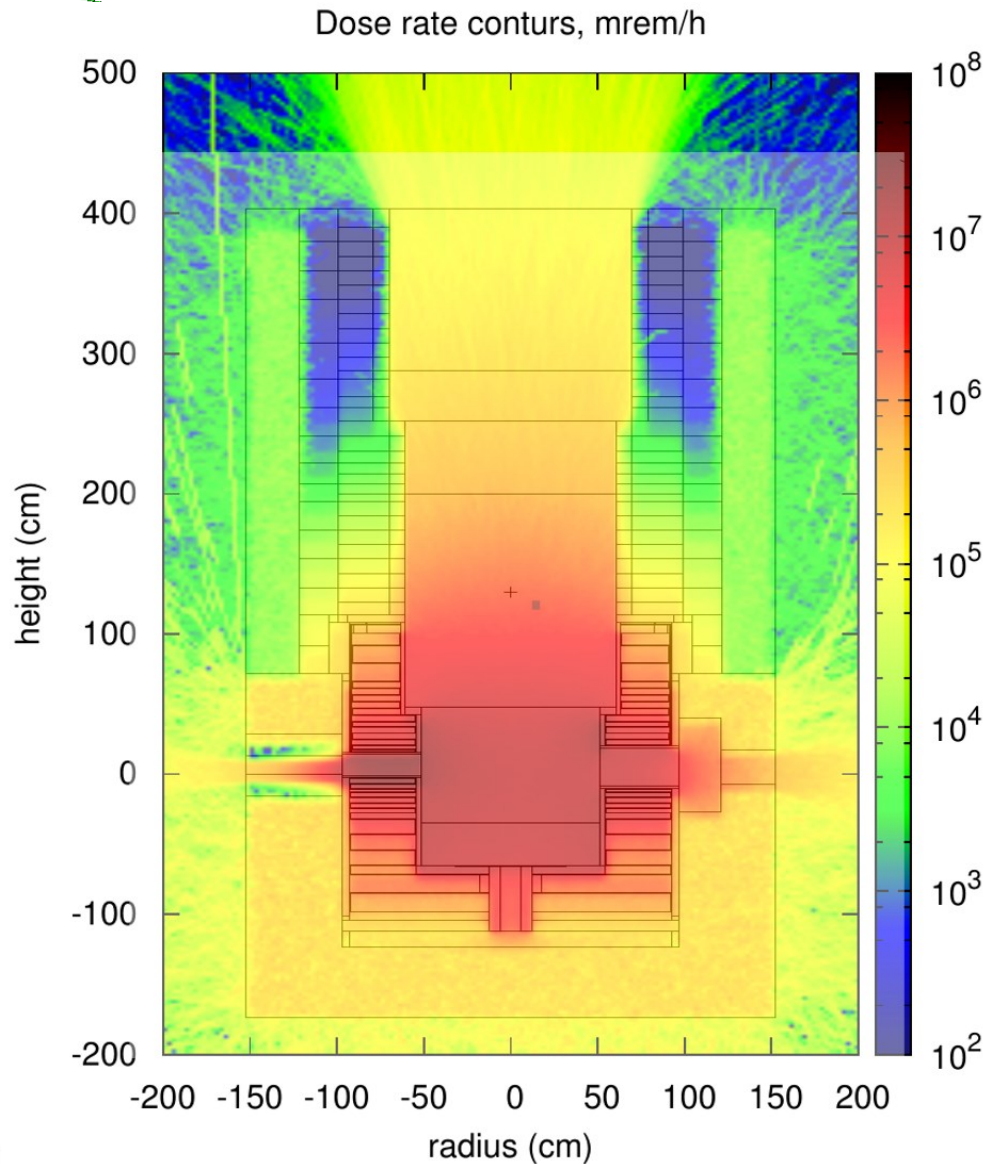
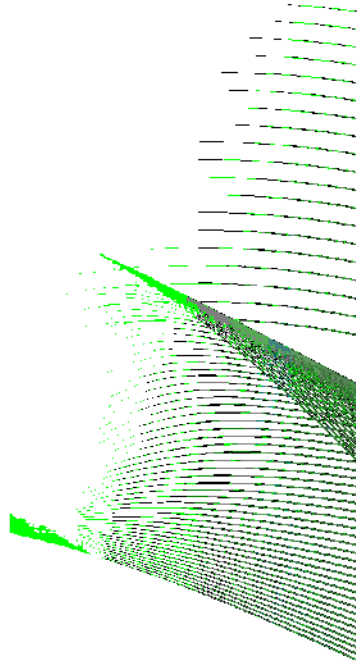


Figure 8. Dose rate contours in and around the IRP pit inside the target monolith, vertical cut along the beam centerline

The details...

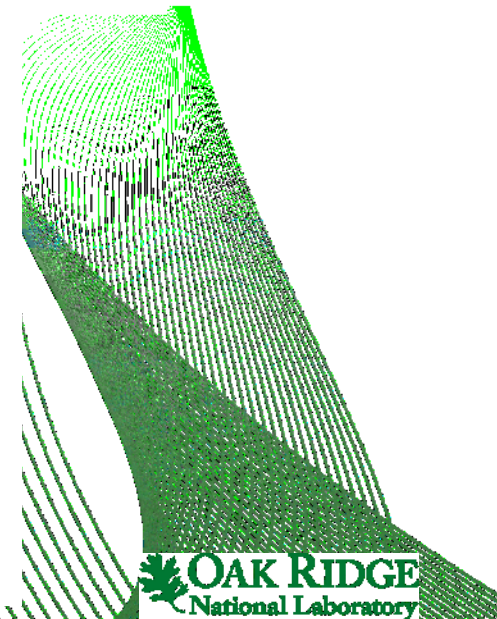


**Approved
ORNL WORK PLAN
Operations, Maintenance and Services**

Work Plan Name / Rev: WP050354 / 0
Expiration Date: 12/20/2022



WORK SCOPE/DESCRIPTION	
Requester (Name/Badge/Division):	Alexander, Chris W / 00978473 / X007
Location of work (Bldg/Rm/Other):	8700 / /
Work Plan Title:	Inner Reflector Plug (IRP) Removal and Installation
Description of Service/Work Needed:	
<p>This work plan WP050354 covers the removal of IRP001, remote camera inspection of the cavity once IRP001 has been extracted, and the installation of IRP002 which will be performed in accordance with TS-IOP-32. Movement of casks (empty & loaded), long reach tools, and all other equipment and tooling that supports the Inner Reflector Plug change-out.</p> <p>EAM #1462565 - Dry Loop 4 for D20 Installation will be performed under WP047102 Work Order will cover disconnecting water lines loop 3 and 4, installing the jumpers, disconnecting the jumpers, connecting the new water utility pipes and testing those connections.</p> <p>EAM #1462570 - Removal and Reinstall of CMS Transfer lines will be performed under WP049631 Work Order will cover cutting transfer lines, connecting the new transfer lines, vacuum testing will be performed under Rob Morton's Work Order and Work Plan.</p>	
Charge Number, if required:	
Work Plan Grade/Worktype:	2 / 0
Author (Name/Badge):	Alexander, Chris W / 00978473
File Attachments:	
INSTRUCTIONS	
Prerequisites/Precautions:	
Prerequisites/Precautions are listed in the Internal Operating Procedure and Work Instructions.	
Directions:	
Refer to the IOP and Work Instructions to perform the Inner Reflector Plug Change-Out.	
Post Work Testing:	
Post Installation Testing is listed in the work instructions	
Closeout:	
Note any important observations that will benefit IRP replacement in the future.	
JOB HAZARD EVALUATION	
HAZARDS	PERMITS / CONTROLS
Hoisting and Rigging (Ensure all personnel involved are properly trained to engage in hoisting and rigging activities.)	<ul style="list-style-type: none"> • Inspections and preventive maintenance is complete: <ul style="list-style-type: none"> ○ Initial inspection ○ Pre-operational inspection ○ Monthly inspection ○ Annual/preventive inspection for H&R equipment [Formerly Verification of current certification / inspections for H&R equipment] (Ensure all hoisting and



The details...

IRP Replacement ALARA Review Planning

Step	Task	Duration (hours)	General Area Worker Dose Rate (mR/hr)	# of Workers Involved	Worker Cumulative Dose (mR)	General Area RCT Dose Rate (mR/hr)	# of RCTs	RCT Cumulative Dose (mR)	Cumulative Dose (mR)	Notes
1	Begin IRP Drying (BUV draining/drying of Loop 4)	4	0	0	0			0	0	
2	Remove T-Beams	6	0	0	0			0	0	
3	Remove Pan Shield Key Blocks	2	0	0	0			0	0	
4	Remove Pan Shield Blocks	8	0	0	0			0	0	
5	Remove Birthday Cake Block	2	0	0	0			0	0	
6	Install Replacement Pan Shield Closeout Plates	4	2	0	0			0	0	
7	Remove Bolts from Upper Core Vessel Lid	1	2	0	0			0	0	
8	Remove Upper Core Vessel Lid	2	2	2	8			0	8	
9	Remove Upper Shield Plate Assembly	1	2	2	4			0	4	
10	Position Piping Waste Container	1	2	2	4			0	4	
11	Perform Piping Cuts required for Upper Segment Removal	0	0	0	0			0	0	
12	Setup HPU and position cutting tools	1	2	2	4	2	1	2	6	
13	Enter Core Vessel and perform cuts	0.25	10	1	2.5	2	1	0.5	3	
14	Place tubing in Shielded Container	0.1	2	2	0.4	2	1	0.2	0.6	
15	Disconnect Piping Flange Connections	0.5	10	1	5		1	0	5	
16	Hold for IRP/ORP Drying Operation Completion	80	0	2	0			0	0	
17	Loosen Tie Rods Securing Upper Segment	0	0	0	0			0	0	
18	Setup tools and prepare to loosen tie rods	2	0	2	0			0	0	
19	Enter Core Vessel and Loosen Rods	0.1	10	1	1	2	1	0.2	1.2	
20	Remove Tie Rods	0.1	10	1	1	2	1	0.2	1.2	
21	Install Shielded Cask Adapter	0	0		0			0	0	
22	Install Rigging onto Adapter and fly into SDER	1.5	0		0			0	0	
23	Place into position on Core Vessel	0.1	2	2	0.4	2	1	0.2	0.6	
24	Install Adapter Plug	0	0		0			0	0	
25	Install Rigging onto Plug and fly into SDER	1	0		0			0	0	
26	Place into position on Core Vessel	0.1	2	2	0.4	2	1	0.2	0.6	
27	Position Upper Segment Cask near Monolith	1	0		0			0	0	
28	Remove Cask and Position onto Cask Adapter	0	0		0			0	0	
29	Install Rigging onto Cask and fly into SDER	0.5	0		0			0	0	
30	Place into position on Shielded Adapter	0.1	2	2	0.4	2	1	0.2	0.6	
31	Ensure Upper Segment Retention Pins are Retracted	0.1	0	1	0			0	0	
32	Lower Hook Extender and engage Upper Segment with Ziplift	0	0		0			0	0	
33	Retrieve Ziplift/Hook Extender and fly into position over cask	0.5	0		0			0	0	
34	Lower Ziplift into Cask and mate with Upper Segment	0.5	2	1	1	2	1	1	2	
35	Raise Upper Segment fully into Cask	0.5	2	1	1	2	1	1	2	
36	Insert Upper Segment Retention Pins	0.25	0		0			0	0	
37	Lower Upper Segment onto Retention Pins	0.1	0		0			0	0	
38	Hoist Cask and Install onto Baseplate	0	0		0			0	0	
39	Rig to Upper Cask	0.5	0		0			0	0	
40	Lift Cask off of Shielded Adapter and out of SDER	0.1	10	1	1			0	1	

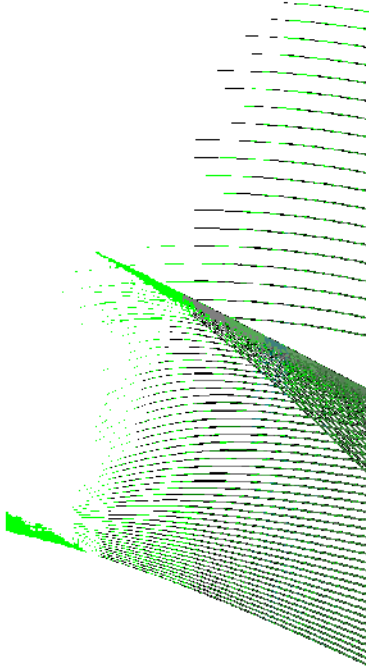
The details...

133	Survey Inspection Tool	0.25	0		0			0	0	
134	Position Inspection Tool back into Stand	0.25	0		0			0	0	Core Vessel Inspection total dose
135	Disconnect Ziplift	0.1	0		0			0	0	414
136	Install Shielded Plug onto Shielded Adapter Plate	0.25	2	1	0.5	2	1	0.5	1	
137	Enter SDER and switch rigging from Plug to Shielded Adapter	0.1	50	1	5	50	1	5	10	
138	Remove Shielded Adapter Assembly from Core Vessel	0.25	5	1	1.25	5	1	1.25	2.5	
139	Install new IRP Module	4	0		0			0	0	
140	Attach rigging to IRP in MUTS	0.5	0		0			0	0	
141	Tie off piping to 50T hook	0.5	0		0			0	0	
142	Lift IRP out of MUTS and to High Bay airlock	0.5	0		0			0	0	
143	Rotate IRP to installation position	0.1	0		0			0	0	
144	Fly IRP into position in SDER	0.5	100	1	50	100	1	50	100	
145	Lower IRP into Core Vessel	0.5	100	1	50	100	1	50	100	
146	Enter SDER for final IRP positioning	0.5	100	2	100	100	1	50	150	
147	Mate all IRP Utility Connections	4	10	2	80	10	1	40	120	
148	Terminate IRP thermocouples	1	10	1	10	10	1	10	20	
149	Perform leak testing, etc.	4	10	3	120	10	1	40	160	
150	Weld H2 Transfer Line Connections	81	2	1	162	2	1	162	324	
151	Install Upper Core Vessel Shielding	1	2	2	4	2	1	2	6	
152	Install Upper Core Vessel Lid	1	2	2	4	2	1	2	6	
153	Install and torque Core Vessel Lid Bolts	1	2	2	4	2	1	2	6	
154	Remove Replacement Pan Shield Plates	2	2	2	8	2	1	4	12	
155	Install Birthday Cake Block	1	0		0			0	0	
156	Install Pan Shield Blocks	8	0		0			0	0	
157	Install Pan Shield Key Blocks	2	0		0			0	0	IRP Installation
158	Install T-Beams	4	0		0			0	0	1017.5
	Total Hours ->	278.47							2955.5	<- Total Cumulative Dose

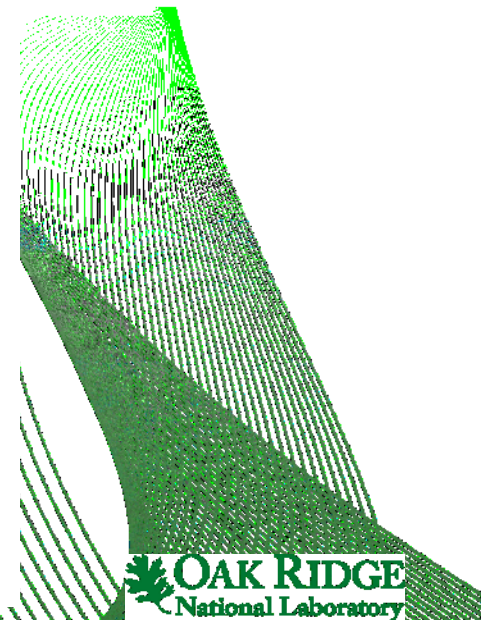
The details...

ALARA Review Checklist		Date: Jan 4, 2018	RWP Number: SNS-24048
Job Description: Innercore Reflector Plug (IRP) removal, core vessel inspection and new IRP installation			
Technical Work Document (s) Title / Number: TS-IOP 032 Inner Reflector Plug Changeout			
Work Location (Building/Room Number): 8700 / SDER/High Bay		Team Lead/Phone Number: Michael Dayton / 865-576-6988	
Radiological work Level: 4		Projected Work Start/End Dates: Jan 29, 2018 / Feb 11, 2018	
Review Completed By (Name/Date): Christi Elam / Jan 12, 2018			
ALARA Trigger Levels (check all that apply)			
<input type="checkbox"/> Removable Contamination > 10,000X Surface Contamination Values		<input type="checkbox"/> Extremity Dose > 10 rem	
<input checked="" type="checkbox"/> Whole Body Dose Rate ≥ 5000 – 10,000 mrem/hr		<input checked="" type="checkbox"/> Individual Dose ≥ 300 – 600 mrem	
<input type="checkbox"/> Whole Body Dose Rate > 10,000 mrem/hr		<input type="checkbox"/> Individual Dose > 600 mrem	
Source Term Reduction (check all that apply and provide details in comment section)			
<input type="checkbox"/> Removal/Shielding of Non-Essential Source		<input type="checkbox"/> Minimization of Primary Source Material	
<input type="checkbox"/> Material Decontamination		<input checked="" type="checkbox"/> Source Decay	
<input checked="" type="checkbox"/> Draining/Flushing Tanks or Pipes		<input type="checkbox"/> Other (detail below)	
Comments: The IRP and Core Vessel will decay for at least 28 days after beam shutdown before work begins. The water cooling loops will be drained prior to cutting the pipes connecting to the IRP. However, due to the depth of the waterlines there is not feasible way to push all the water out of the cooling loop lines.			
Containment/Contamination Control (check all that apply and provide details in comment section)			
<input type="checkbox"/> Temporary Containment Structure		<input type="checkbox"/> HEPA Vacuum	
<input type="checkbox"/> Glovebags		<input type="checkbox"/> Fixative or Wet Coatings	
<input type="checkbox"/> Drainage/Spillage Catchment		<input checked="" type="checkbox"/> Covering/Coating Uncontaminated Surfaces	
<input type="checkbox"/> Facility HEPA Ventilation Configuration		<input type="checkbox"/> Sleaving	
<input type="checkbox"/> Local/Spot HEPA Ventilation		<input checked="" type="checkbox"/> Perform Air Flow Verification	
<input type="checkbox"/> Glovebox/Hood (specify)		<input checked="" type="checkbox"/> Provide Doffing Assistance	
<input checked="" type="checkbox"/> Multiple Stage Doffing		<input type="checkbox"/> Other (detail below)	
Comments: Two-stage doffing will be utilized with RCT assistance. Exposed surfaces in the SDER will be covered to prevent contamination. Utilize herculite or other contamination control barriers where practical when transferring contaminated items over floor. Air flow verification over the Core Vessel will be performed periodically through out the project using smoke tests and flow alarms on the PCE and SCE will be monitored.			

The details...



Controls To Be Included in Technical Work Documents						
Radiation protection control throughout the project with hold points for assessment and approvals after each significant change in conditions.						
Controls To Be Included in Radiological Work Permit						
Limiting Conditions: Measured dose rate at planar opening of vessel with middle and bottom IRP segment in place in excess of 5 Rem/hr. Measured dose rate at planar opening of vessel with bottom IRP segment in place in excess of 10 Rem/hr. General Area Contamination levels greater than or equal to 10,000,000 dpm/100 cm ² Beta-gamma in SDER. Contamination levels greater than or equal to 50,000 dpm/100cm ² beta-gamma outside posted Contamination Area. Required Radiological Training: Radiological Worker II Dosimetry: TLD and EPD. EPD Alerts/alarms: Dose Rate (mrem/hr) b/g: 5,000 Total Dose (mrem) b/g: 600 PPE: single. Gloves - double. Respiratory Protection: Not required Air Sampling: Required ; PAS Sampling: Not Required Protection Coverage: Continuous RCT monitoring required						
Other Controls						
DOSE ESTIMATES						
Task	Number of Personnel	Location	Stay Time (hours)	Dose Rate (mrem/hr)	Collective Dose (mrem/hr)	Max. Individual Dose (mrem)
Upper & Middle IRP Segment Removal	6	SDER/High-Bay	133	2 to 1,000	537	100
Lower IRP Segment Removal	5	SDER/High-Bay	9	20 to 5,000	987	390
Core Vessel Inspection	4	SDER/High-Bay	18	50 to 100	414	150
IRP Installation	6	SDER/High-Bay	124	2 to 100	1018	325
Total Estimated Collective Dose (mrem): 2956		Maximum Estimated Individual Dose (mrem): 640				



The details...

AOR18: ALARA Operational Review for the SNS Inner Reflector Plug (IRP) Project

Revision 0



1.0 Introduction and Background

The purpose of this ALARA operational review is to ensure that the appropriate engineering, administrative and radiological controls will be in place to reduce the individual and collective dose to workers and minimize the risk of contamination during the removal of IRP01, core vessel inspection and the installation of IRP02. This project is the first of its kind at SNS. IRP01 is the original installed prior to the initial operation of SNS. The remote handling team has replaced several proton beam windows and targets, and has performed other jobs involving high radiation levels and contamination risk successfully. The IRP replacement will encounter higher dose rates than any other project in the history of SNS operations. Detailed planning and testing has been performed in preparation for the IRP replacement.

2.0 Summary of Major Work Tasks

2.1 Old IRP Removal

The first major task of this project is the removal and storage of the old IRP. The IRP will be removed in three segments that will be stored in shielded casks. Each segment removal will require cutting and removal of water supply lines and tie rod removal for the upper and middle segments. Due to expected high radiation levels the middle and lower segment pipe cuts and tie rod removals must be performed remotely using long-reach tools. For each segment removal the storage cask will be placed over the core vessel opening and the segment will be pulled up into the cask for removal to storage. An adaptor plate will be installed over the top of the core vessel flange providing a platform for the shielding casks and to reduce the radiation shine from the IRP cavity.

2.2 Core Vessel Inspection

Using the Core Vessel (CVI) inspection tool, the Survey and Alignment group (SAM) will inspect the seating of the V-block mating surfaces between the CVI inspection tool and the Outer Reflector Plug (ORP) using the inspection tool camera. The results of this inspection may require removal of the inspection tool from the core vessel to adjust the V-blocks. This work could take several iterations. Once the V-blocks are aligned correctly the inspections of the ports will be performed using the camera. A laser tracker will be used over the open core vessel with the IRP inspection tool installed to measure the fiducials located on top of the IRP inspection tool.

2.3 IRP Installation

The adaptor plate, block and shield plate will be removed from the open cavity by crane and the new IRP will be brought in and lowered into the IRP cavity. Once the

The details...

Table 1. Residual dose rates from the removed IRP pipes at 30 cm distance

Dose rate, mrem/h	Vertical pipe top segment removed	Horizontal pipe top segment removed	L-shaped pipe middle segment removed	Vertical pipe middle segment removed
lowest	2	14	70	35
highest	9	23	350	100

The details...

IRP Removal Piping Information

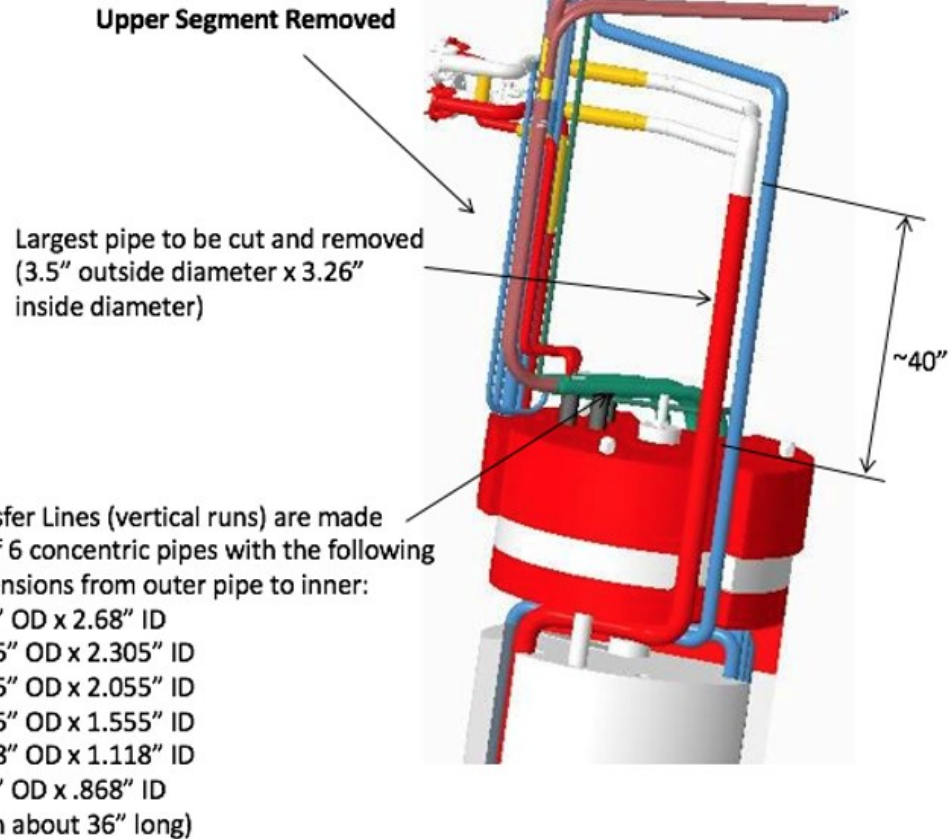
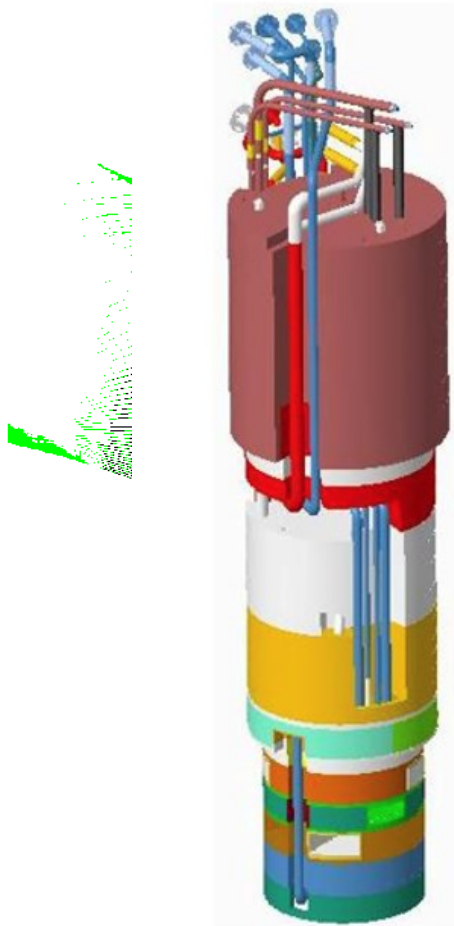


Figure 1. IRP with top segment removed

The details...

Transfer Lines (vertical runs) are made up of 6 concentric pipes with the following dimensions from outer pipe to inner:

- 2.75" OD x 2.68" ID
 - 2.375" OD x 2.305" ID
 - 2.125" OD x 2.055" ID
 - 1.625" OD x 1.555" ID
 - 1.188" OD x 1.118" ID
 - .938" OD x .868" ID
- (each about 28" long)

This is what it looks like when we cut it



2.875" outside diameter x
2.469" inside diameter x ~ 36" long
(horizontal runs) ~ 33" long (vertical runs)

Middle Segment Removed

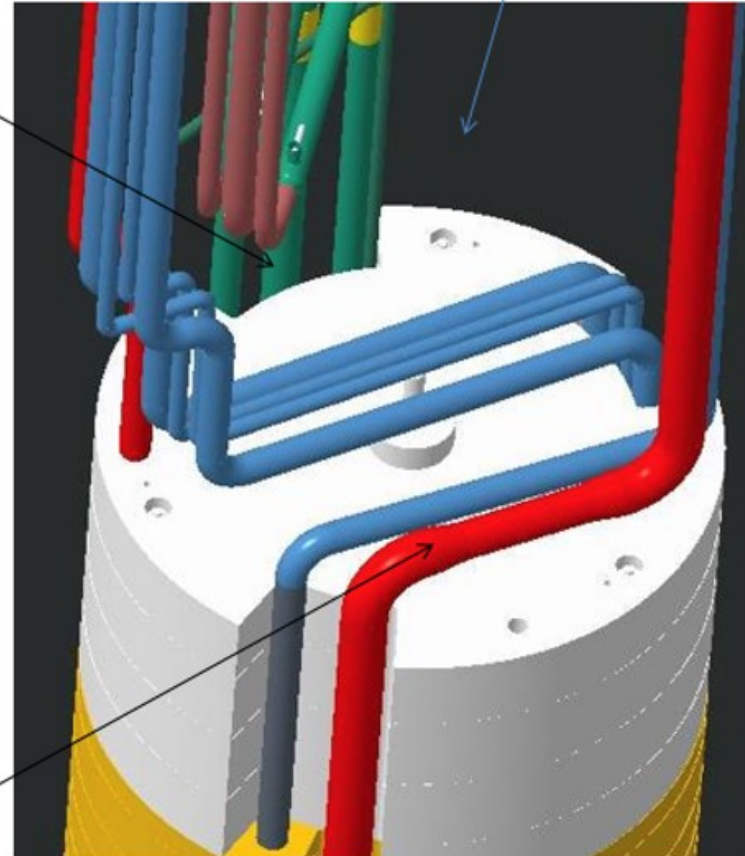
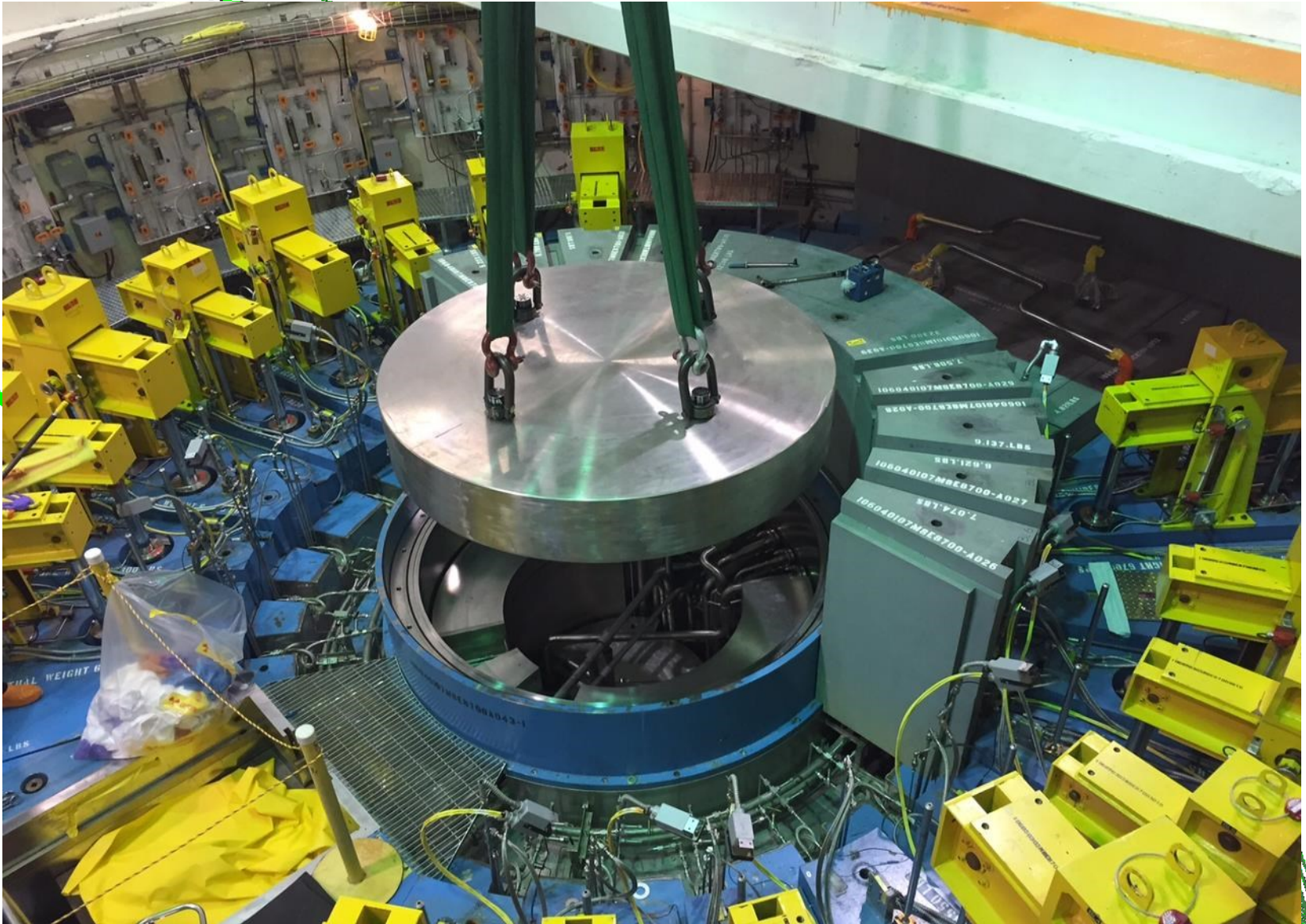


Figure 2. IRP with middle segment removed

The details...



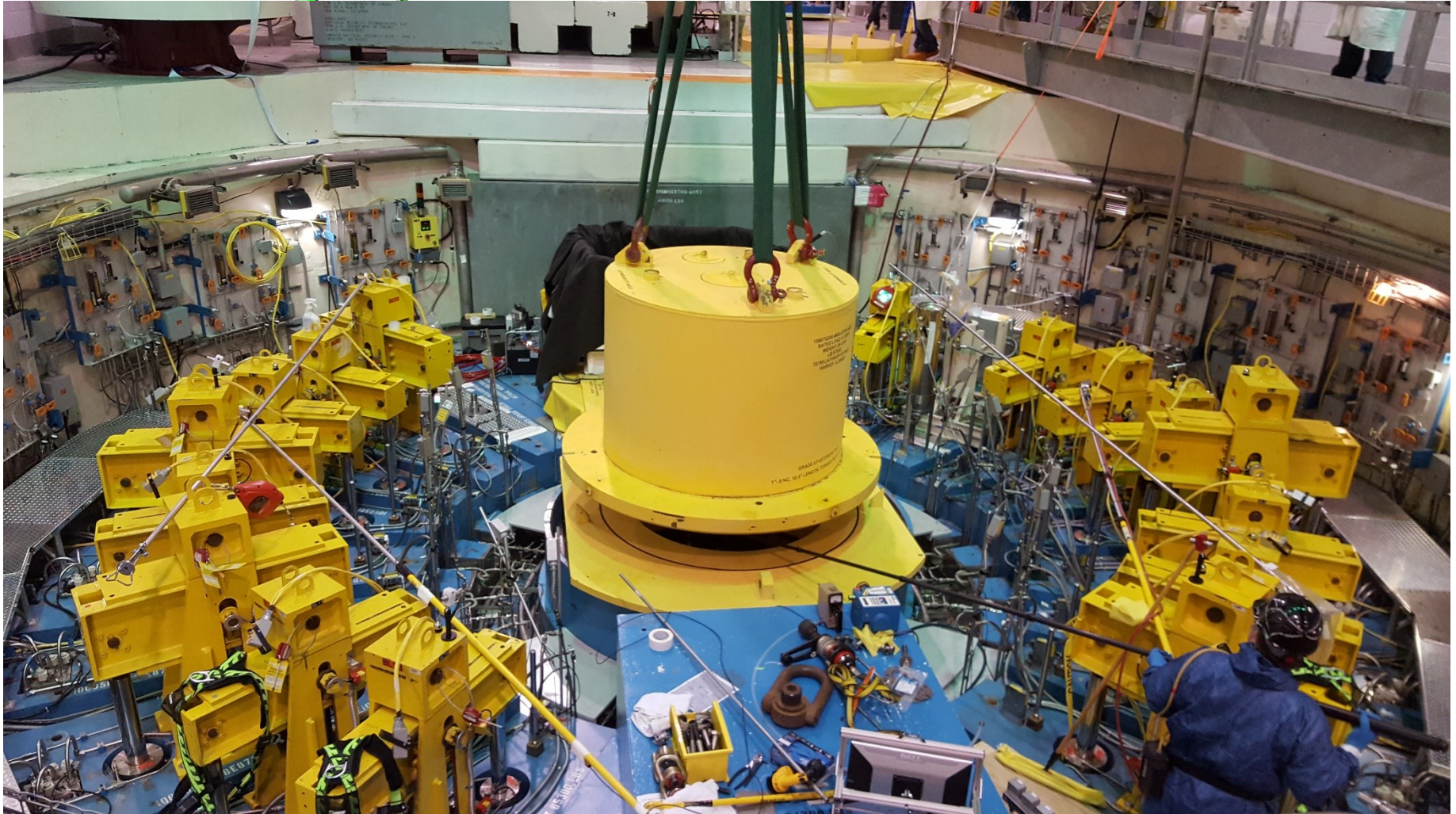
Summary of Radiological Conditions

- Projected person-rem: 2.9
- Dose rate anticipated: 500 rem/h at the surface plane
- Contamination limiting condition on RWP: 10,000,000 dpm/100cm² β-γ in SDER (excluding ³H), assuming mercury spallation products

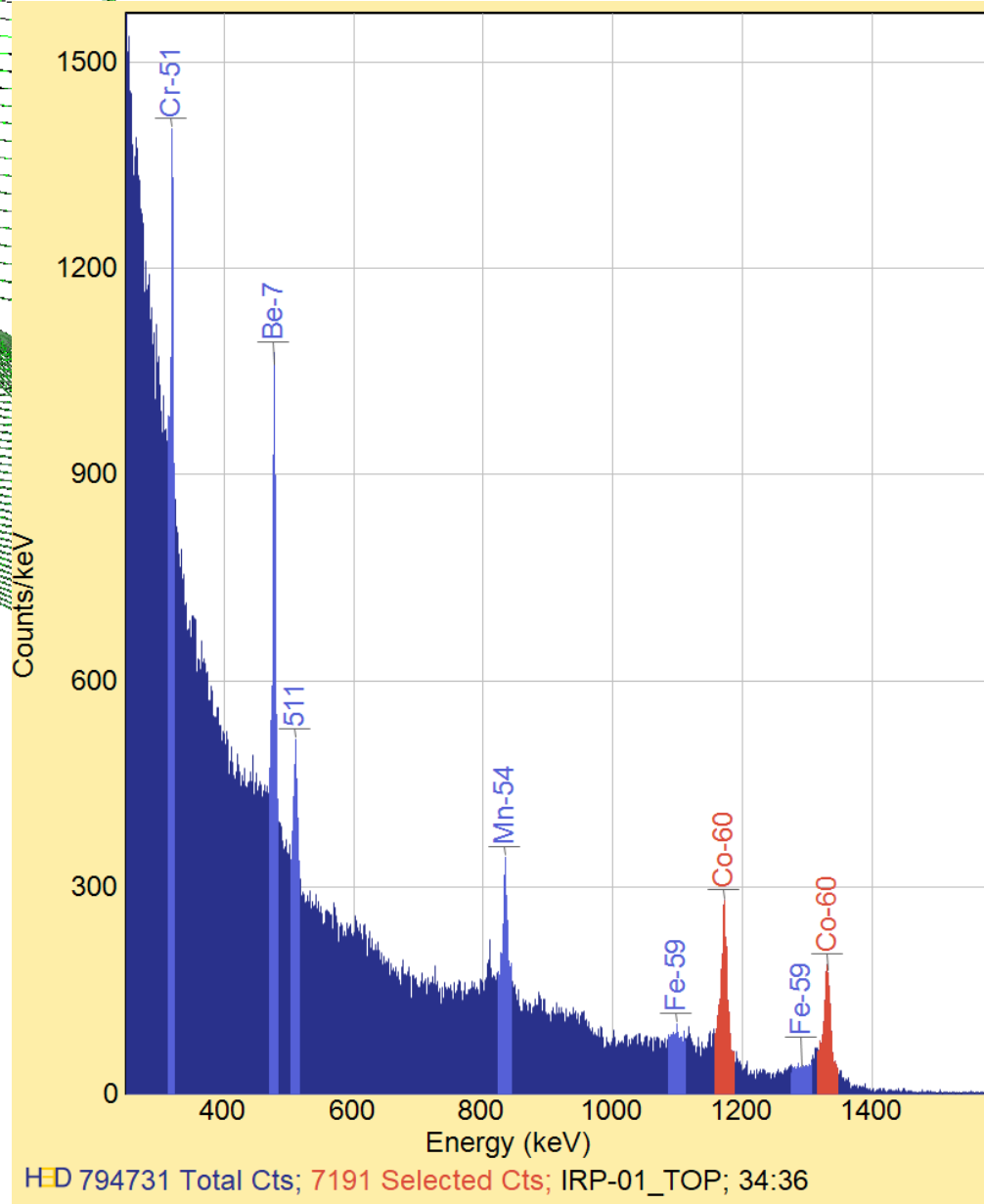
The Big Event



The Big Event



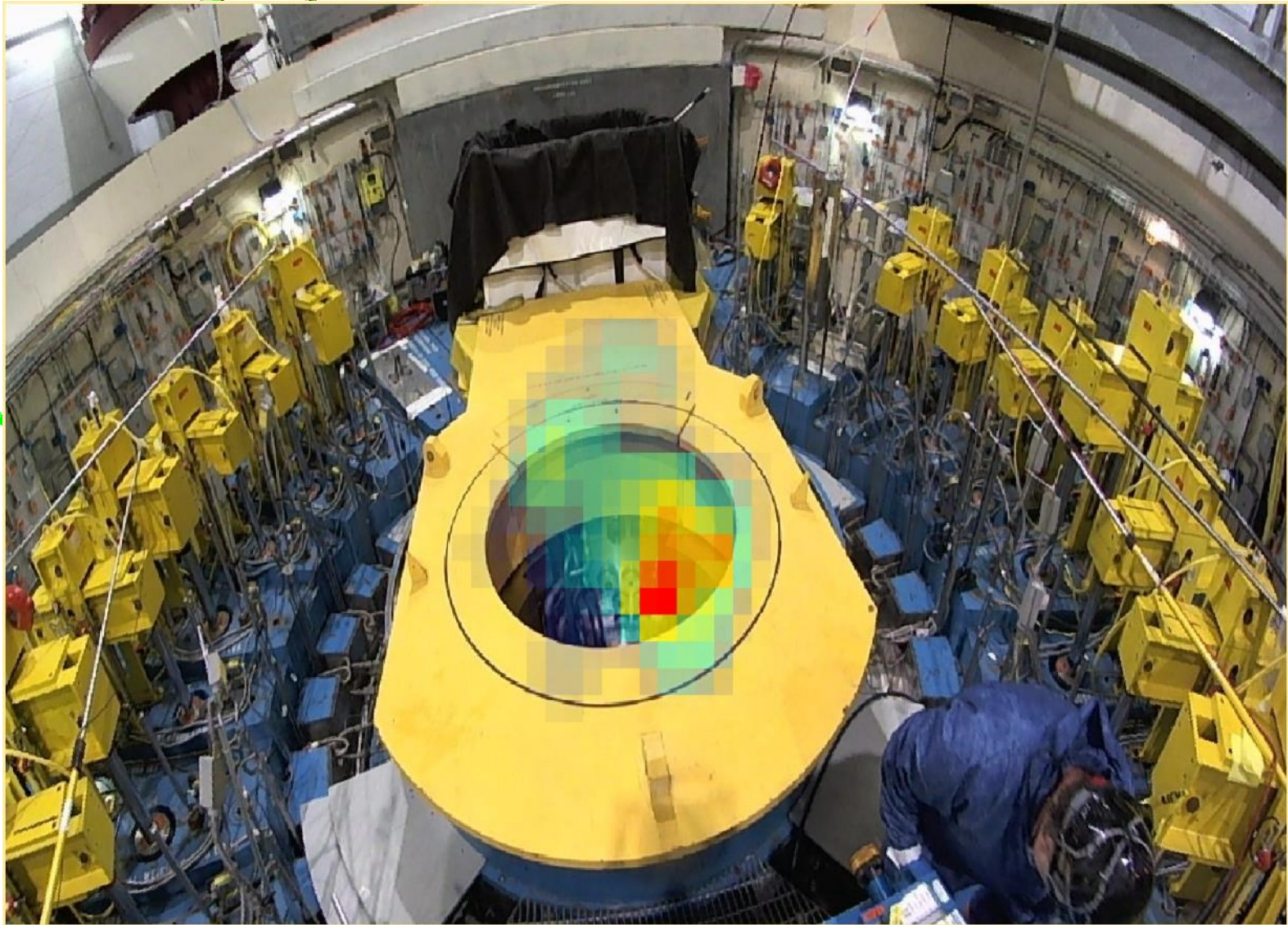
The Big Event



The Big Event

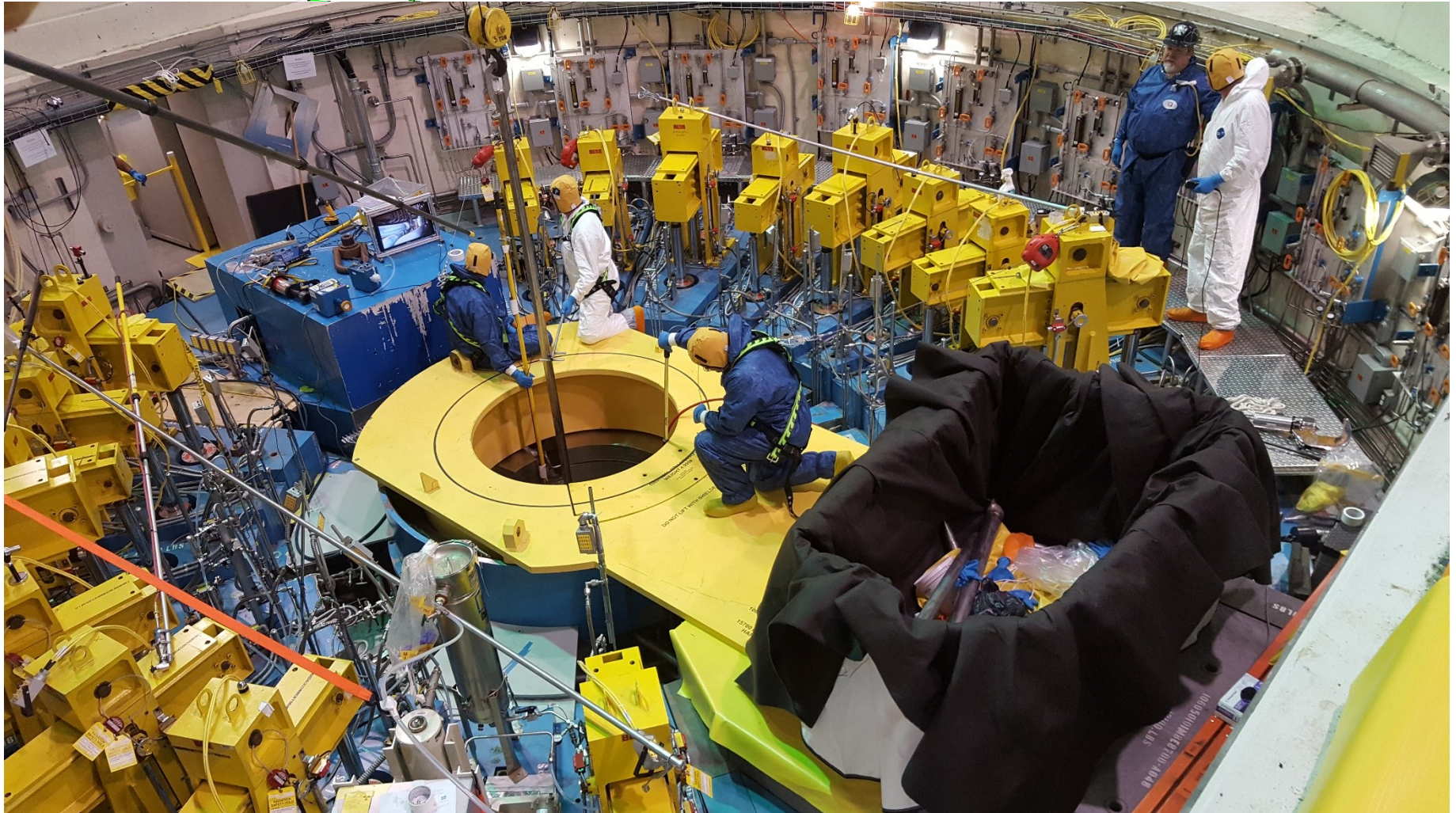


The Big Event



H D 16189 Imaged Cts; .Dose 250-1500 keV; open_with_lower_segment_in_SDER(High Res.); 16:13

The Big Event



The Big Event



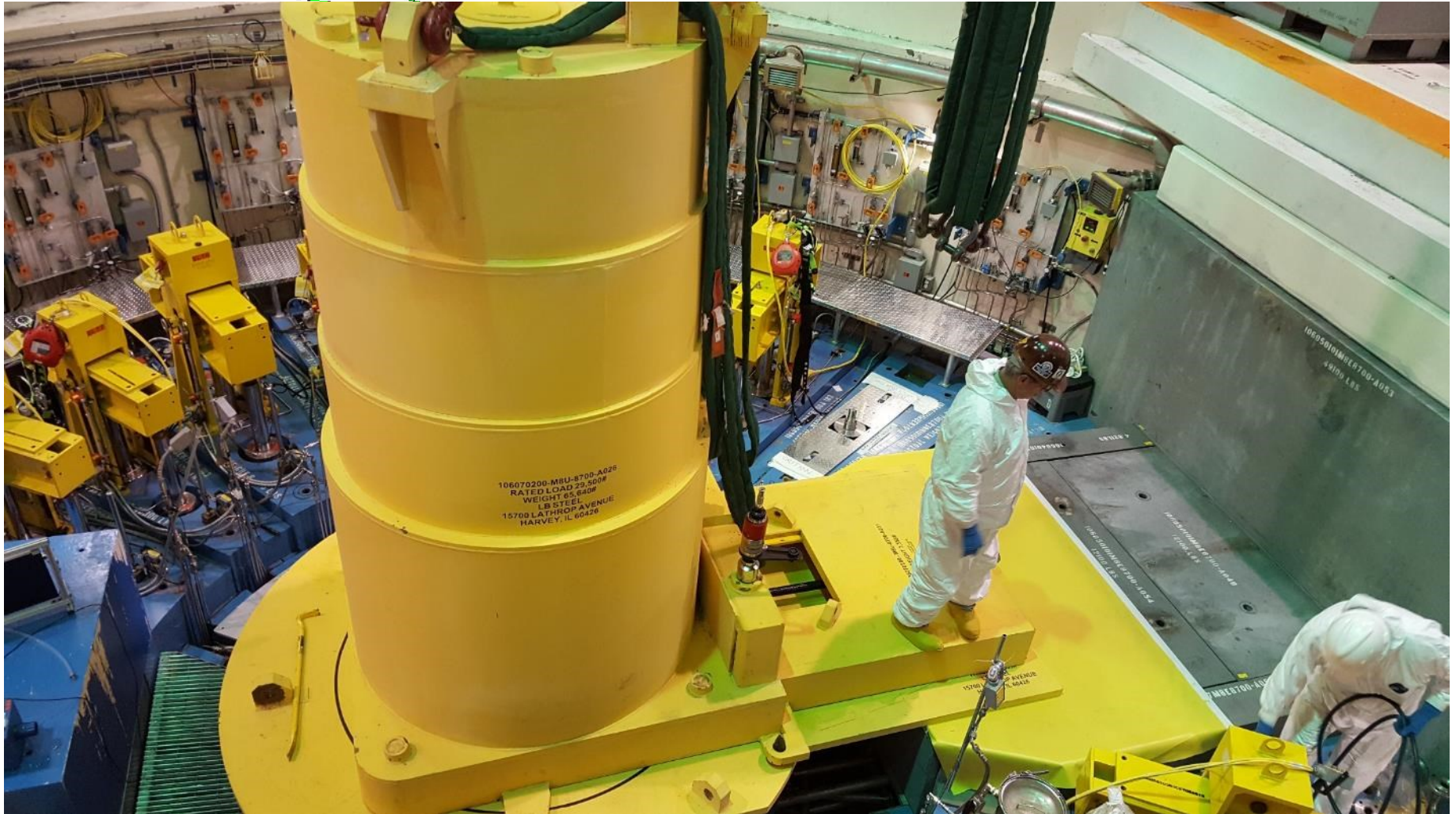
The Big Event

gar | EPD-N | Beta CAM | Rad51 | PD(E)-4 | DT375 |

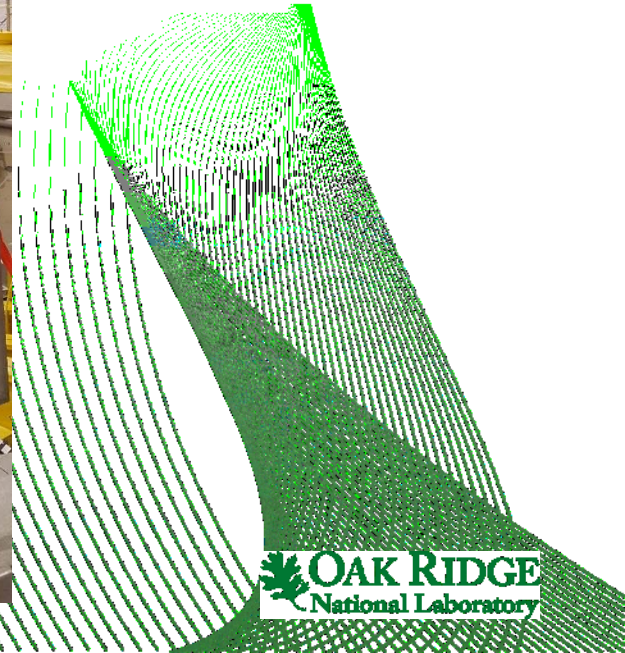
Order	Hp Dose (mrem)	Hp Rate (mrem/h)	Hs Dose (mrem)	Hs Rate (mrem/h)
	0.0	0.0	0.0	0.0
	0.0	0.5	0.2	1.0
	0.0	0.1	0.1	0.0
	0.0	0.0	0.0	0.0
	0.0	0.1	0.0	0.0
	0.9	10.1	0.8	10.0
	0.0	0.2	0.0	0.0
	0.0	0.0	0.0	0.0

Report Time
12:29:11 PM
12:29:12 PM
12:29:10 PM
12:29:58 PM
12:29:13 PM
12:29:10 PM
12:29:10 PM
12:29:12 PM

The Big Event



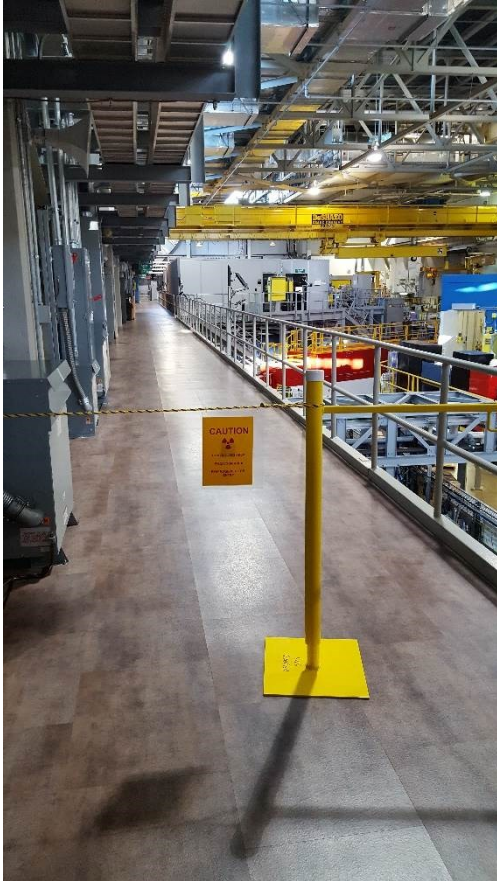
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The Big Event



The Big Event



The Big Event



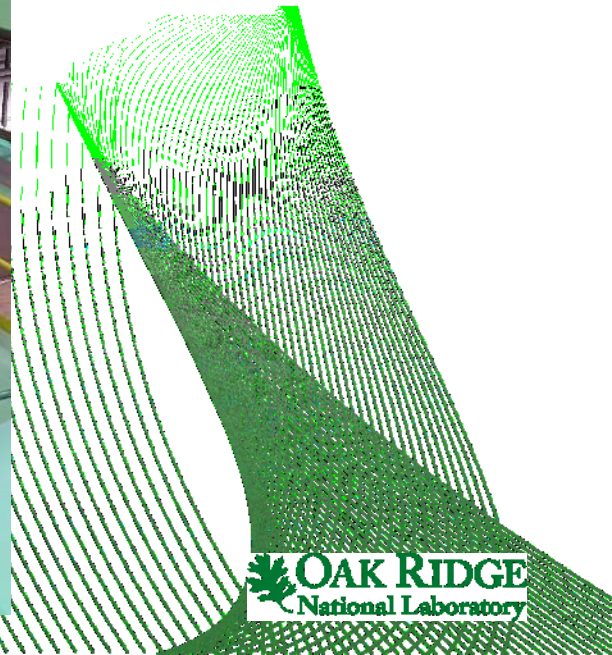
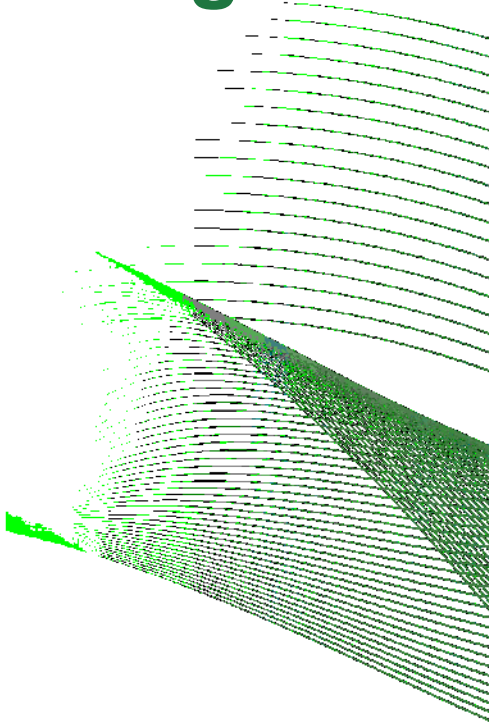
The Big Event



The Big Event



The Big Event



The Big Event



Skyshine

04/18/18 11:49:45

GAMMA SOURCE TERM FROM IRP (with
roof)

probid = 04/18/18 11:49:45

basis: XZ

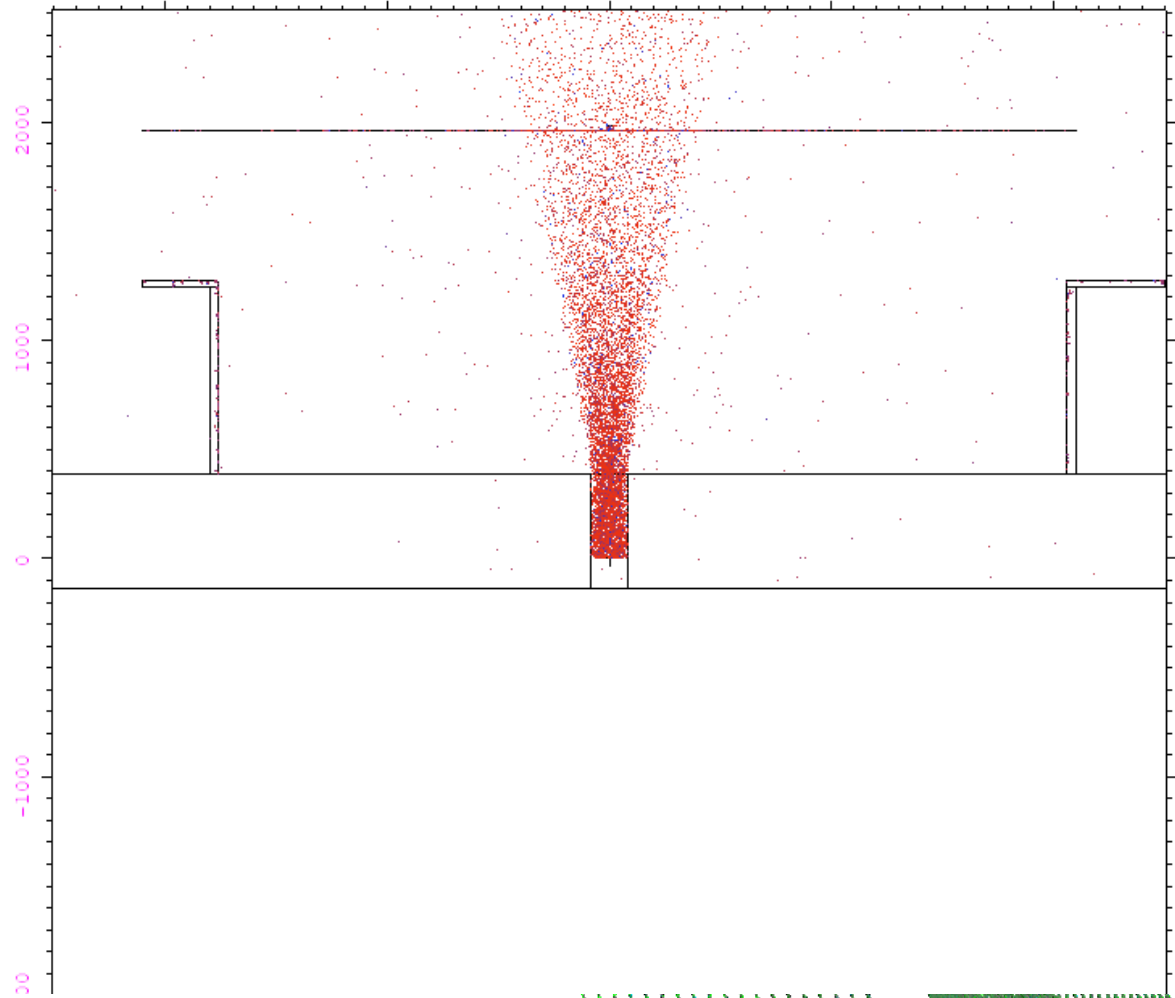
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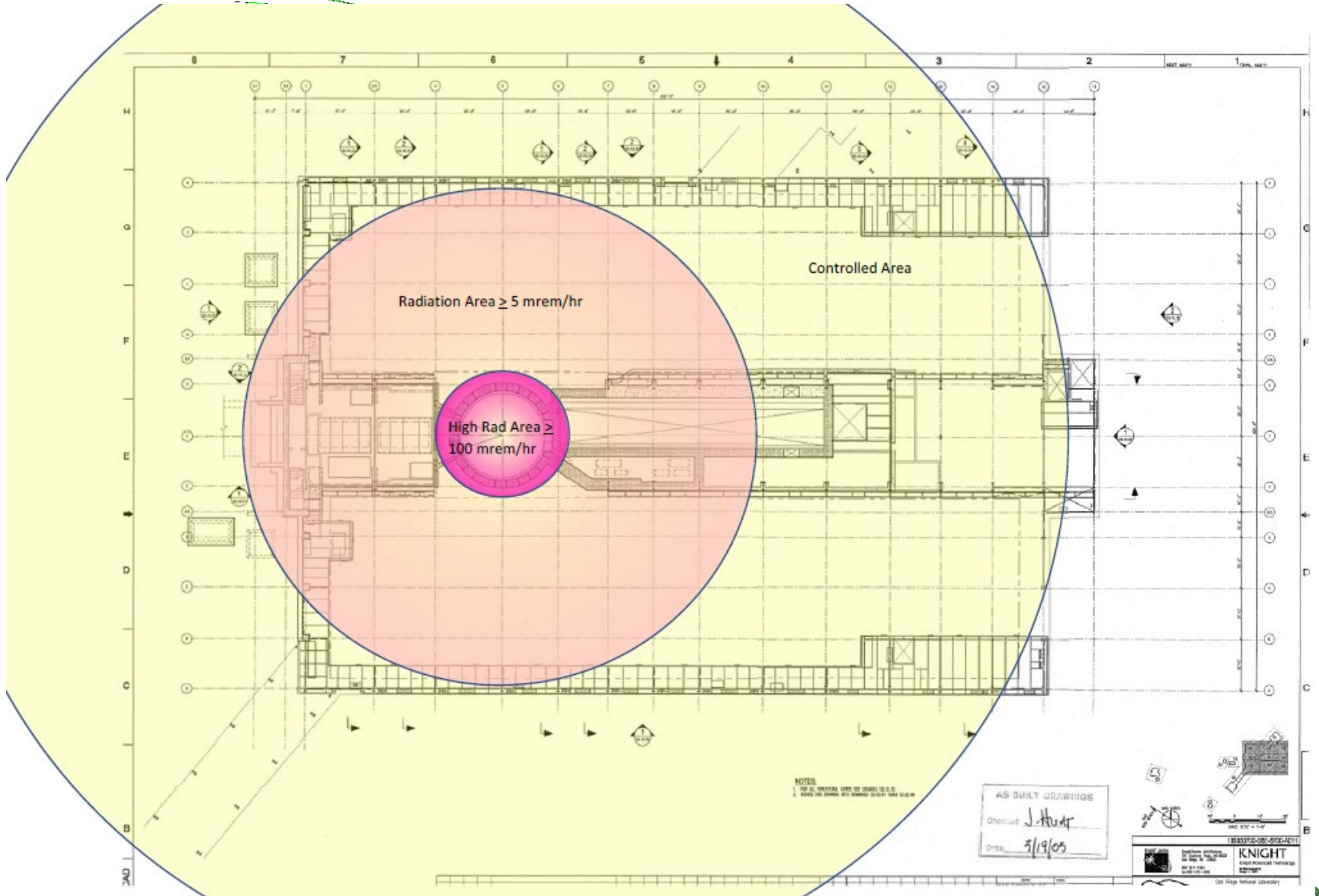
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Skyshine

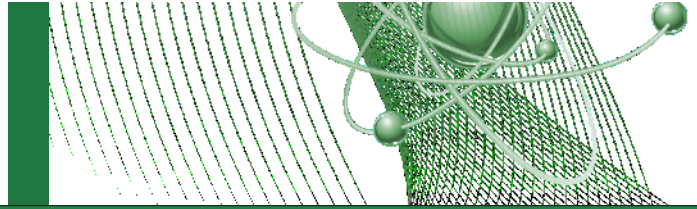
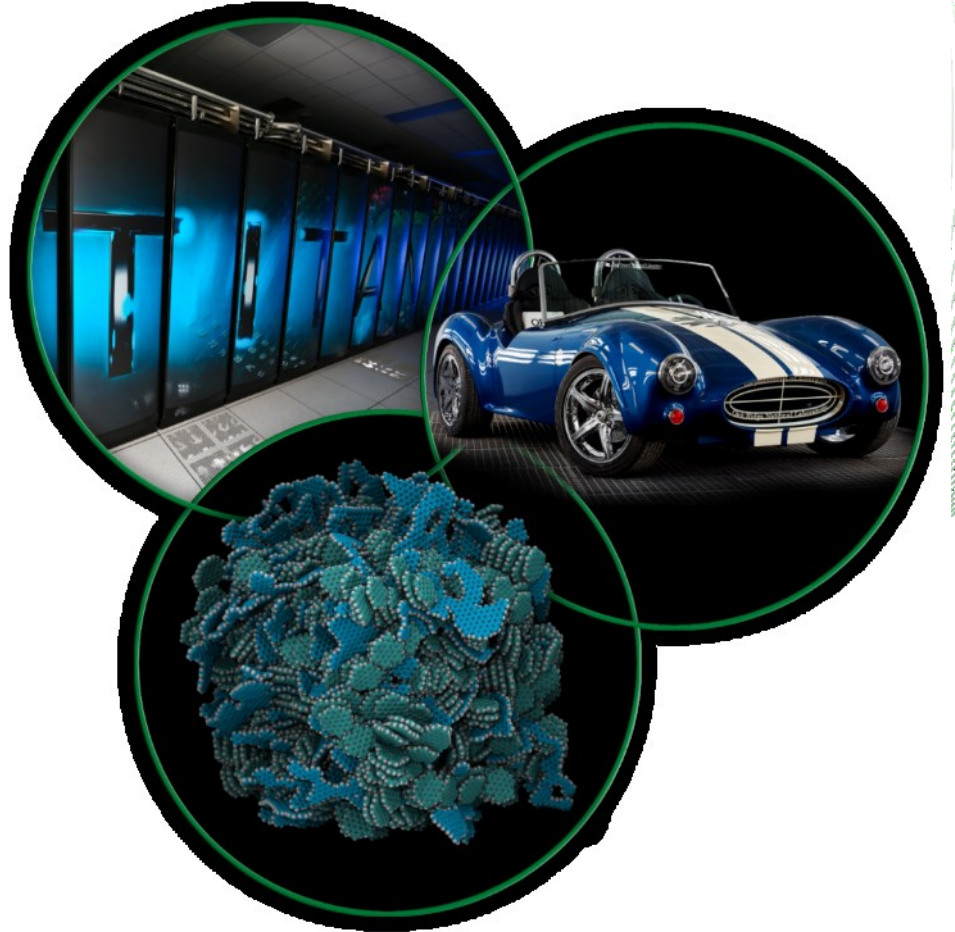
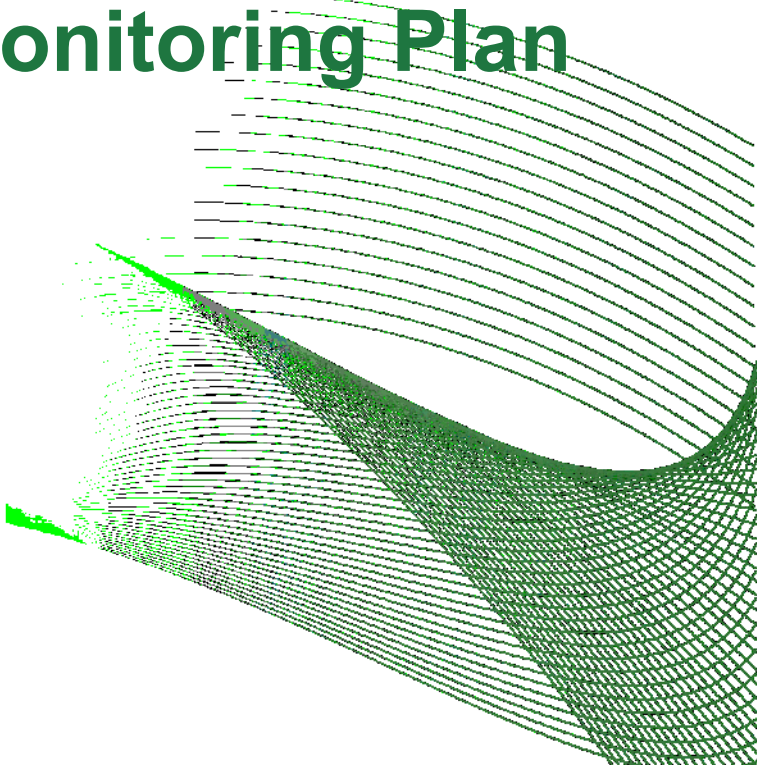


Skyshine

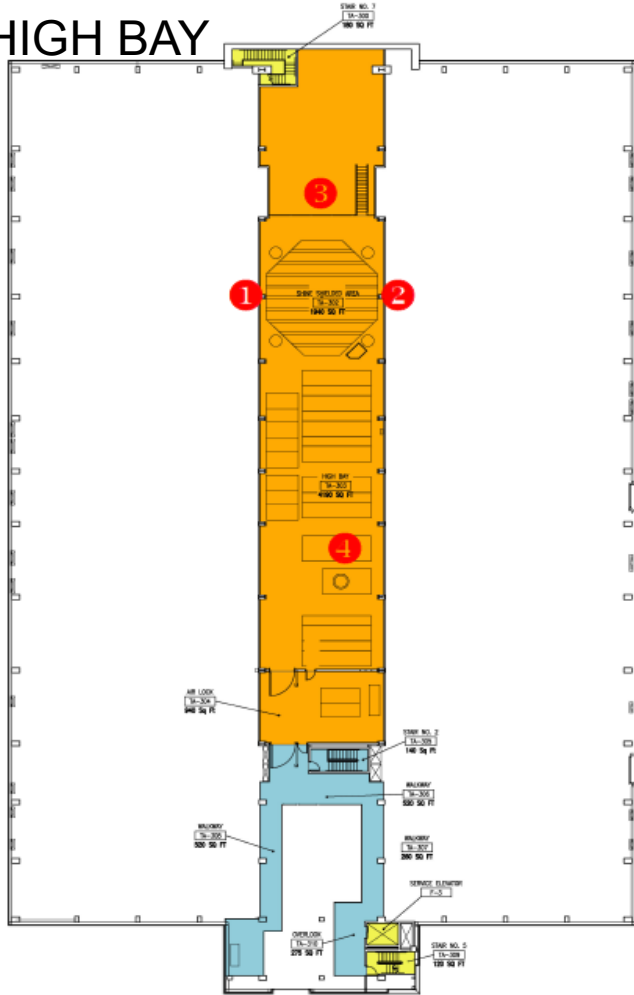
Table 5. Isotopic total activity (Ci) in the structural materials of the SNS pit with contribution over 100Ci and their residual gammas energy.

NUCLIDE	HALF-LIFE	SHUT-DOWN	<u>1 H</u>	<u>1 D</u>	<u>7 D</u>	<u>28 D</u>	Energy for decay gammas, MeV
Sc 46	7.24E+06	4.03E+02	4.03E+02	4.00E+02	3.80E+02	3.20E+02	1.10E+00
<u>V 48</u>	1.38E+06	3.30E+03	3.29E+03	3.16E+03	2.44E+03	9.80E+02	1.30E+00
<u>V 49</u>	2.92E+07	4.28E+03	4.28E+03	4.27E+03	4.22E+03	4.04E+03	no gammas
Cr 51	2.39E+06	8.14E+04	8.14E+04	7.94E+04	6.84E+04	4.04E+04	3.00E-01
Mn 54	2.70E+07	1.14E+04	1.14E+04	1.14E+04	1.13E+04	1.08E+04	8.00E-01
Fe 55	8.62E+07	2.79E+04	2.79E+04	2.78E+04	2.77E+04	2.73E+04	1.00E-01
Fe 59	3.84E+06	1.20E+03	1.20E+03	1.18E+03	1.08E+03	7.78E+02	1.10E+00
Co 56	6.80E+06	1.11E+03	1.11E+03	1.10E+03	1.05E+03	8.72E+02	
Co 57	2.35E+07	3.29E+03	3.29E+03	3.28E+03	3.24E+03	3.07E+03	1.00E-01
Co 58	6.13E+06	5.33E+03	5.33E+03	5.31E+03	5.01E+03	4.08E+03	8.00E-01
Co 60	1.66E+08	9.94E+03	9.94E+03	9.94E+03	9.92E+03	9.84E+03	1.30E+00
Ni 63	3.16E+09	3.73E+02	3.73E+02	3.73E+02	3.73E+02	3.73E+02	no gammas
TOTAL		2.38E+05	2.04E+05	1.76E+05	1.42E+05	1.03E+05	

2018 IRP Rad Monitoring Plan



HIGH BAY

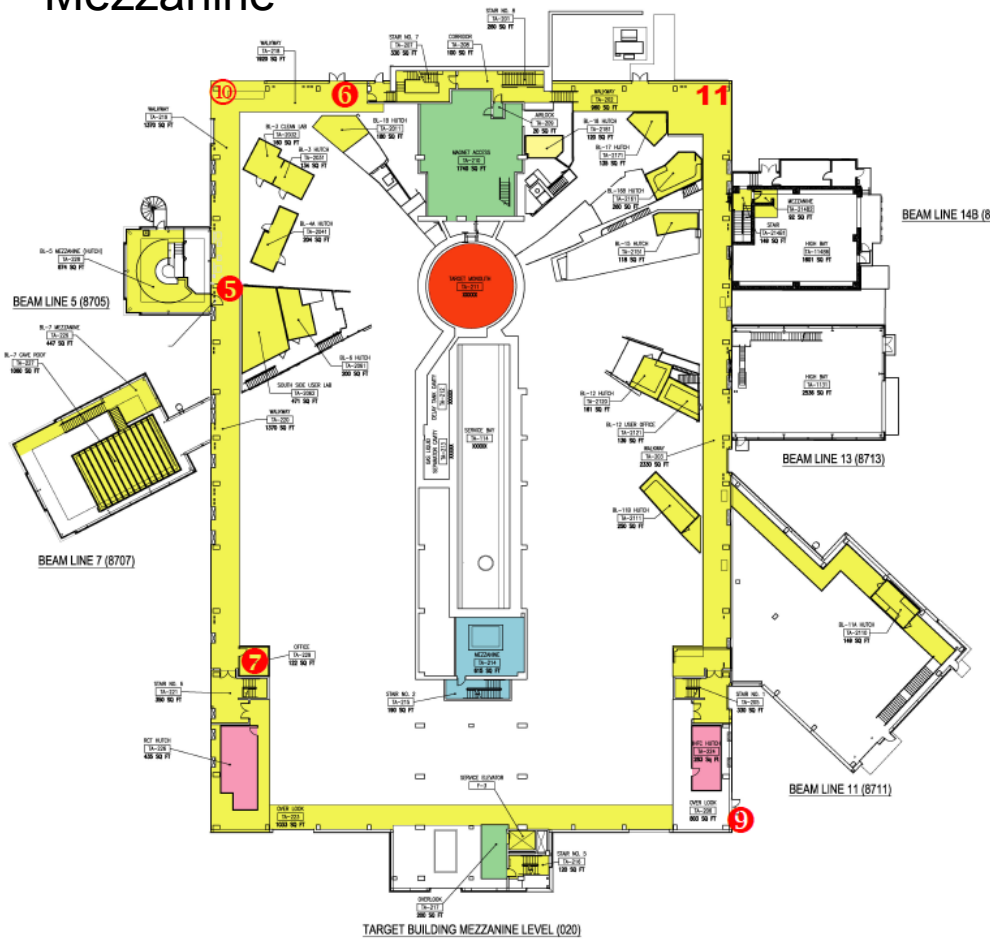


TARGET BUILDING HIGH BAY LEVEL (030)

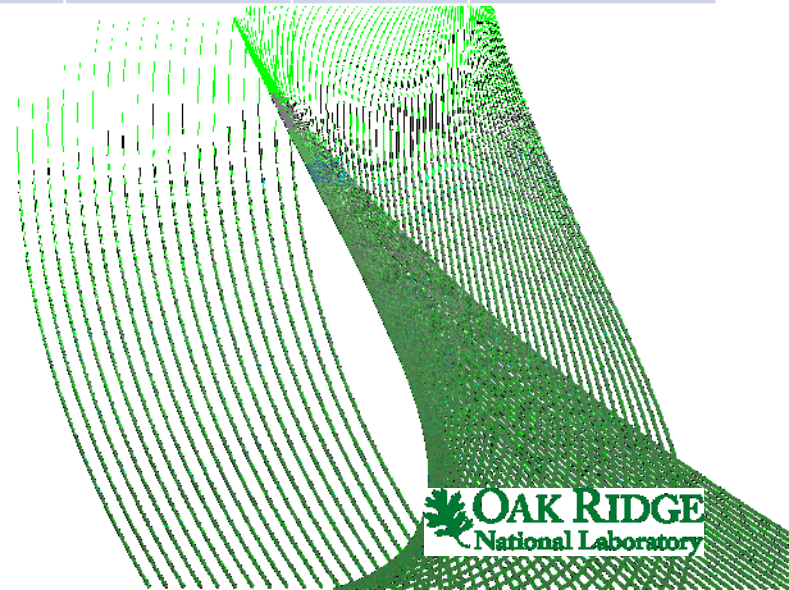
Location	Description	Instrument	Comment
1	High Bay Column E-5	Ecogamma	Ethernet and Brackets
1	High Bay Column E-5	G64	Ethernet and Brackets
2	High Bay Column G-5	Ecogamma	Ethernet and Brackets
2	High Bay Column G-5	G64	Ethernet and Brackets
3	SDER Entrance	G64	Ethernet and Brackets
4	Remote Operators Control	G64	Ethernet
4	Remote Operators Control	Overhoff	Sampling SDER
4	Remote Operators Control	Overhoff	Sampling "Mission Control"
4	Remote Operators Control	Low Vol	Sampling SDER
4	Remote Operators Control	Low Vol	Sampling "Mission Control"
4	Remote Operators Control	CPU	Horizon
4	Remote Operators Control	iCAM	Sampling "Mission Control"

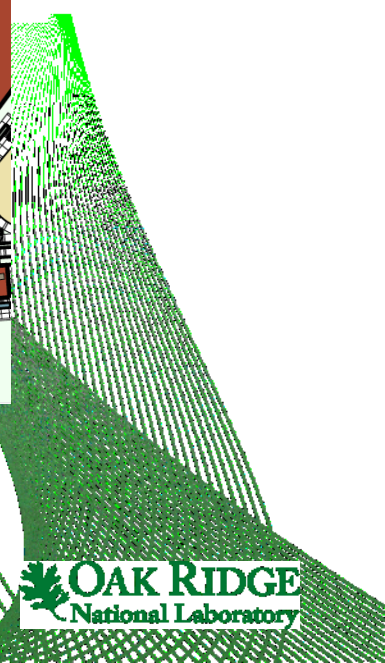
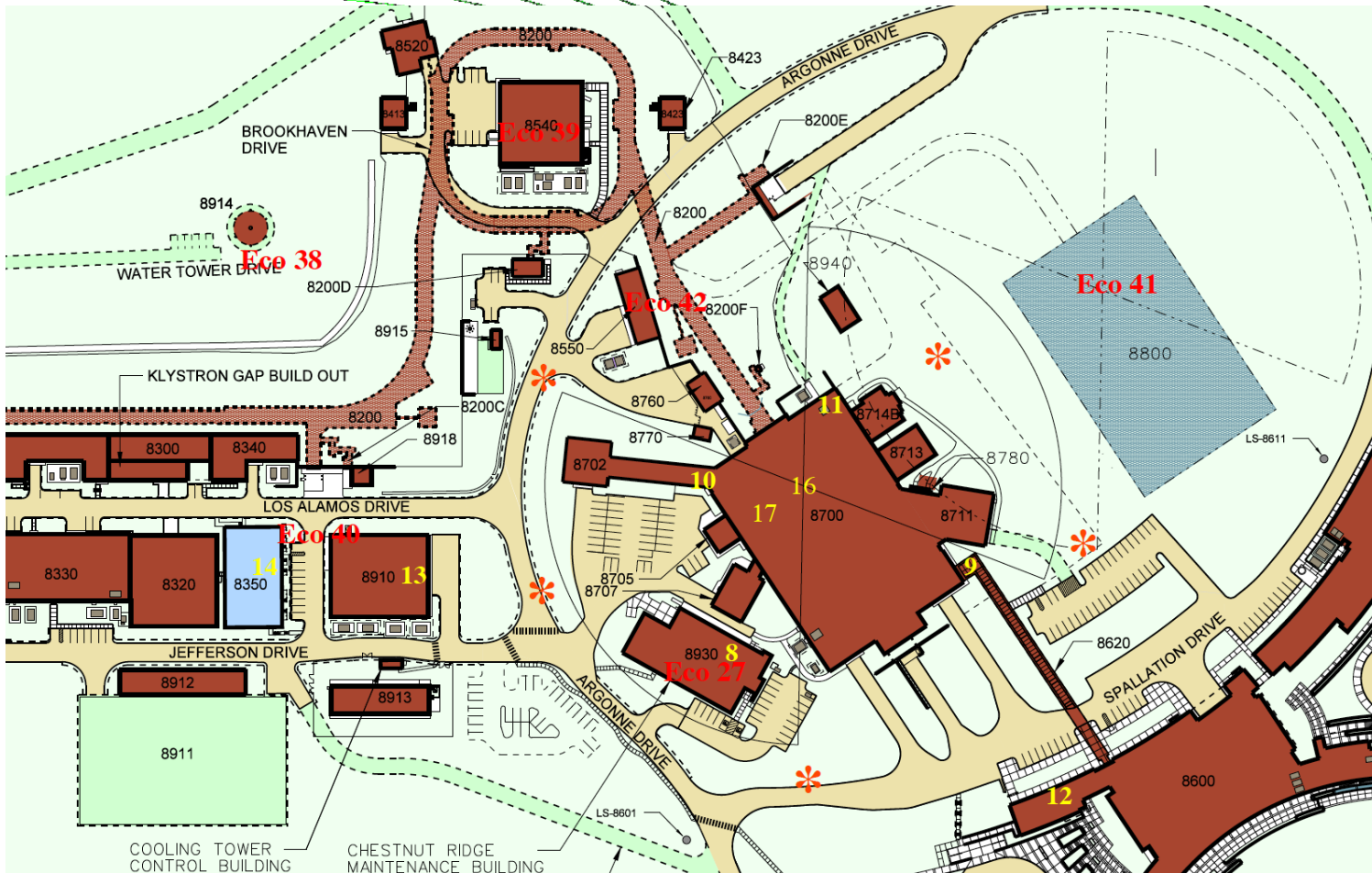


Mezzanine



Location	Description	Instrument	Comment
5	Mezzanine Column A-5	Ecogamma	Ethernet and Bracket
6	Exterior Entrance	Ecogamma	Ethernet and Bracket
7	RCT Instrument Hutch	G64	
9	Southeast Corner	Instadose	
10	Northwest Corner	Instadose	
11	Northeast Corner	Instadose	





Instruments Needed

Location	Description	Instrument(s)	Comment		Phase 1 - Upper Section Removed		Phase 2 - Middle Section Removed		Phase 3 - Lower Section Removed	
					Low Level Alarm	High Level Alarm	Low Level Alarm	High Level Alarm	Low Level Alarm	High Level Alarm
1	High Bay South SDER	Eco-1268	Ethernet and Brackets	Anticipated:	0.02		0.08		10	
				Setpoint:	2.0	5.0	5.0	10.0	50.0	80.0
2	High Bay North SDER	Eco-8700-TA225	Ethernet and Brackets	Anticipated:	0.02		0.08		10	
				Setpoint:	2.0	5.0	5.0	10.0	50.0	80.0
5	Mezzanine Column A-5	Eco-1261	Ethernet and Bracket	Anticipated:	0.01		0.04		5	
				Setpoint:	2.0	5.0	2.0	5.0	10.0	20.0
6	Mezzanine West (Nomad)	Eco-1269	Ethernet and Bracket	Anticipated:	0.01		0.04		5	
				Setpoint:	2.0	5.0	2.0	5.0	10.0	20.0
12	8600	Ecogamma	J-300-E	Anticipated:	0.00		0.00		0.2	
				Setpoint:	0.5	1.0	0.5	1.0	0.5	1.0
8	8930 (Roof)	Ecogamma (BOX) Eco-SNS	Already present	Anticipated:	0.00		0.01		1	
				Setpoint:	0.5	1.0	0.5	1.0	1.0	2.0
14	8350	Ecogamma (BOX) Eco-SNS-03	Ecogamma already present	Anticipated:	0.00		0.00		0.2	
				Setpoint:	0.5	1.0	0.5	1.0	1.0	2.0
16	Roof - 8700 Directly over IRP	Ecogamma (BOX) Eco-SNS-01	Relocate ECO-SNS-0 1	Anticipated:	18		92		11,000	
				Setpoint:	50.0	100.0	200.0	500.0	20,000.0	40,000.0
17	Roof - 8700 Above BL-6	Ecogamma (BOX) Eco-SNS-02	Relocate ECO-SNS-0 2	Anticipated:	0.01		0.04		5	
				Setpoint:	2.0	5.0	2.0	5.0	10.0	50.0
18	Roof - 8550	Ecogamma (BOX) Eco-SNS-05	Already Present	Anticipated:	0.00		0.01		1	
				Setpoint:	0.5	1.0	0.5	1.0	1.0	4.0
1	High Bay Column E-5	G64-5215	Ethernet and Brackets	Anticipated:	0.02		0.08		10	
				Setpoint:	2.0	5.0	5.0	10.0	50.0	80.0
2	High Bay Column G-5	G64-5208	Ethernet and Brackets	Anticipated:	0.02		0.08		10	
				Setpoint:	2.0	5.0	5.0	10.0	50.0	80.0
3	SDER Entrance	G64-5213	Ethernet and Brackets	Anticipated:	0.02		0.08		10	
				Setpoint:	2.0	5.0	5.0	10.0	50.0	80.0
4	Remote Operators Control	G64-5212	Ethernet	Anticipated:	0.01		0.03		3	
				Setpoint:	2.0	5.0	2.0	5.0	10.0	20.0
7	RCT Instrument Hutch	G64-5187		Anticipated:	0.00		0.02		2	
				Setpoint:	2.0	5.0	2.0	5.0	3.0	5.0

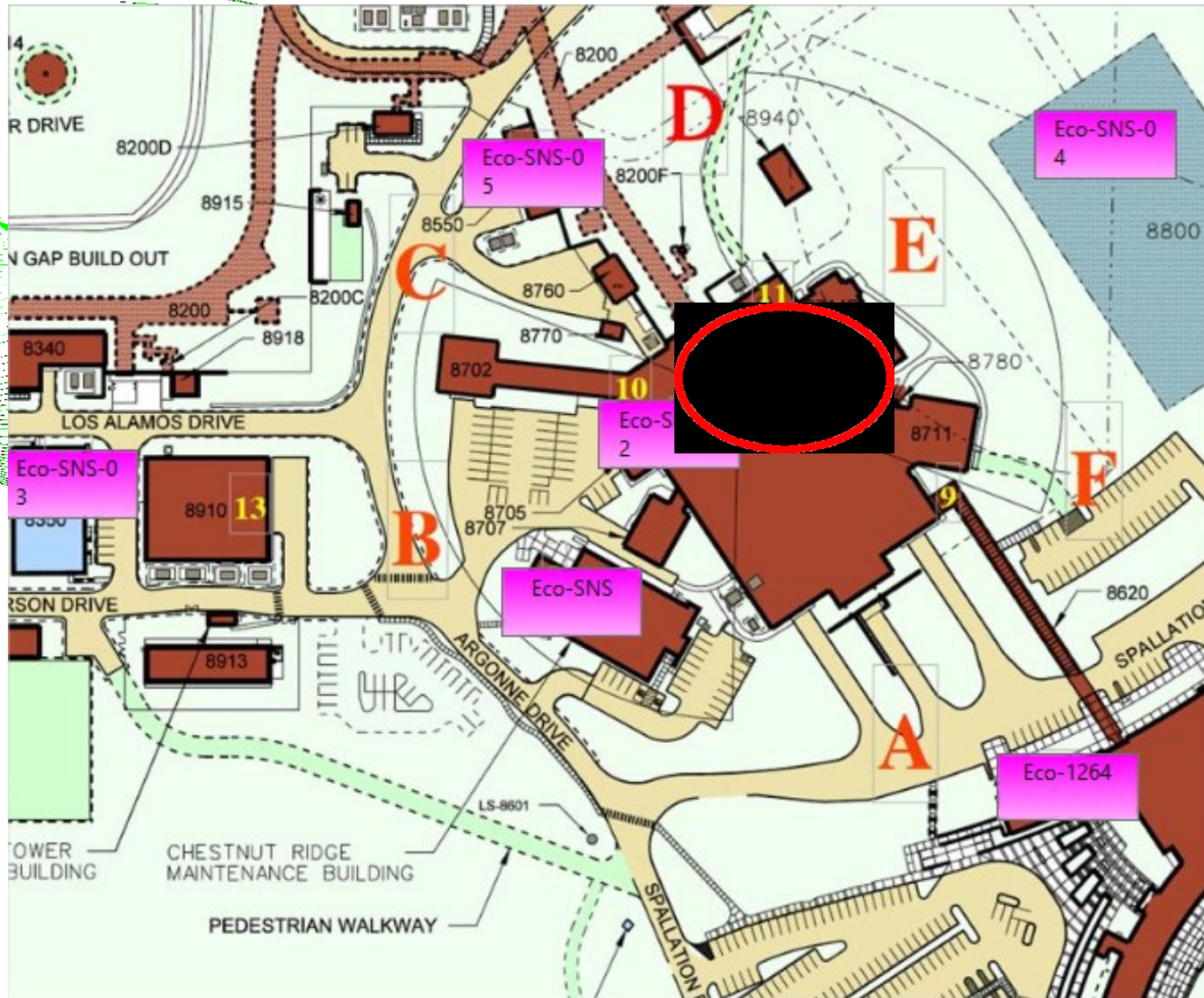
Instruments Needed



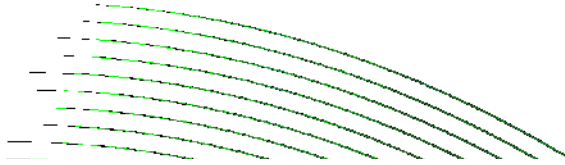
Skyshine



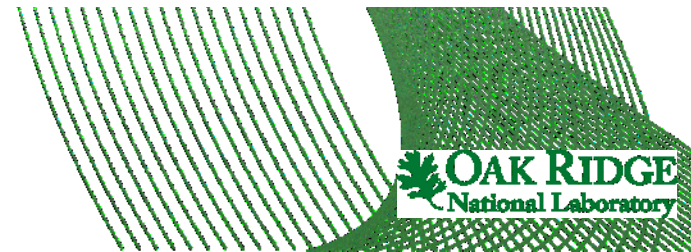
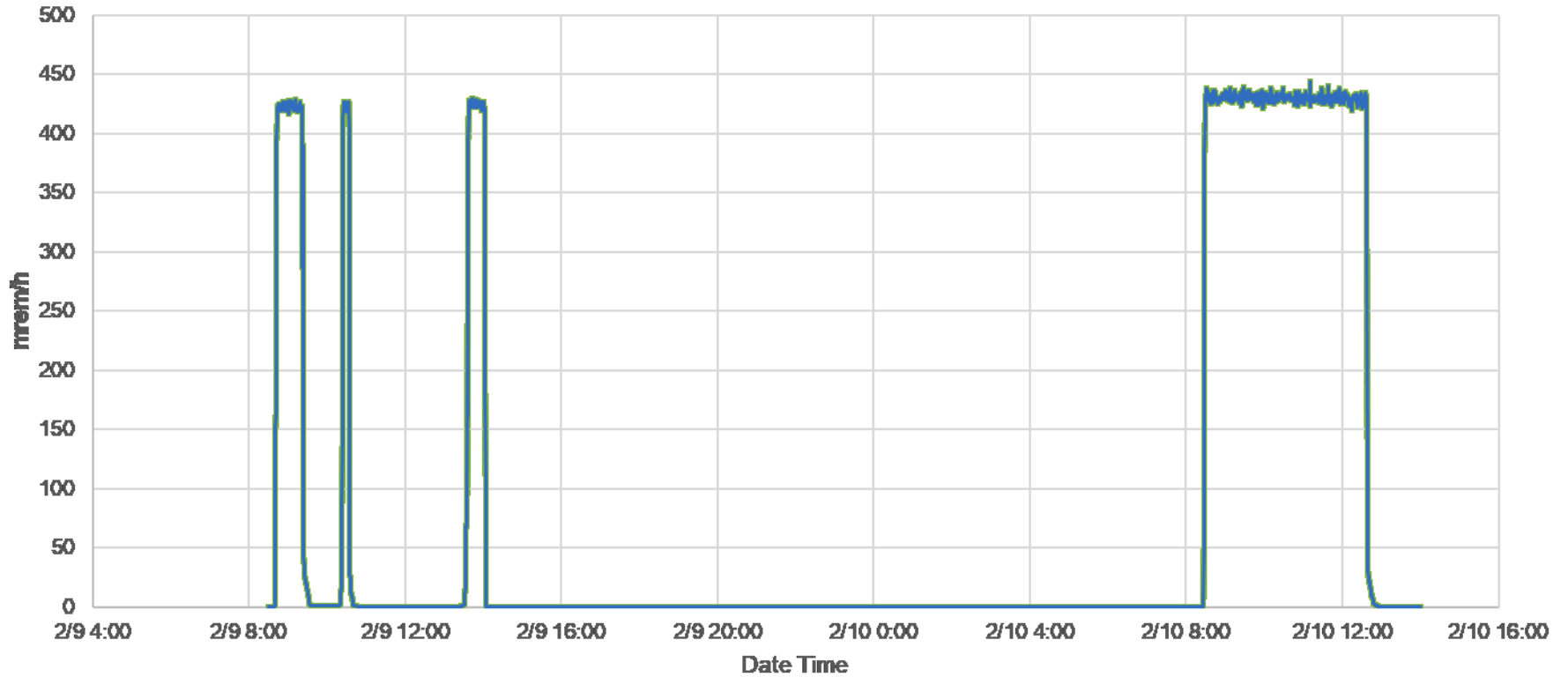
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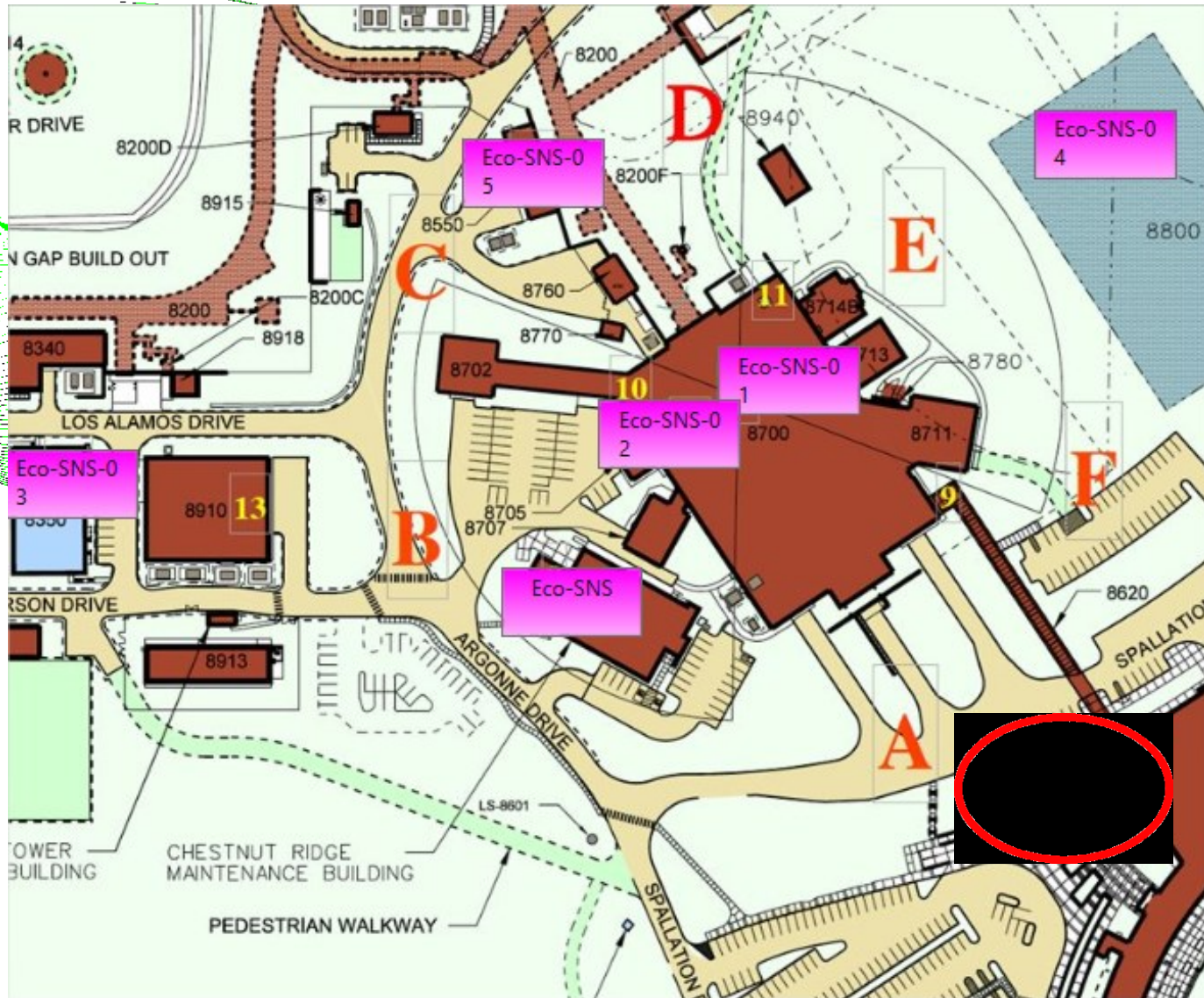
Skyshine



Roof Dose Rate

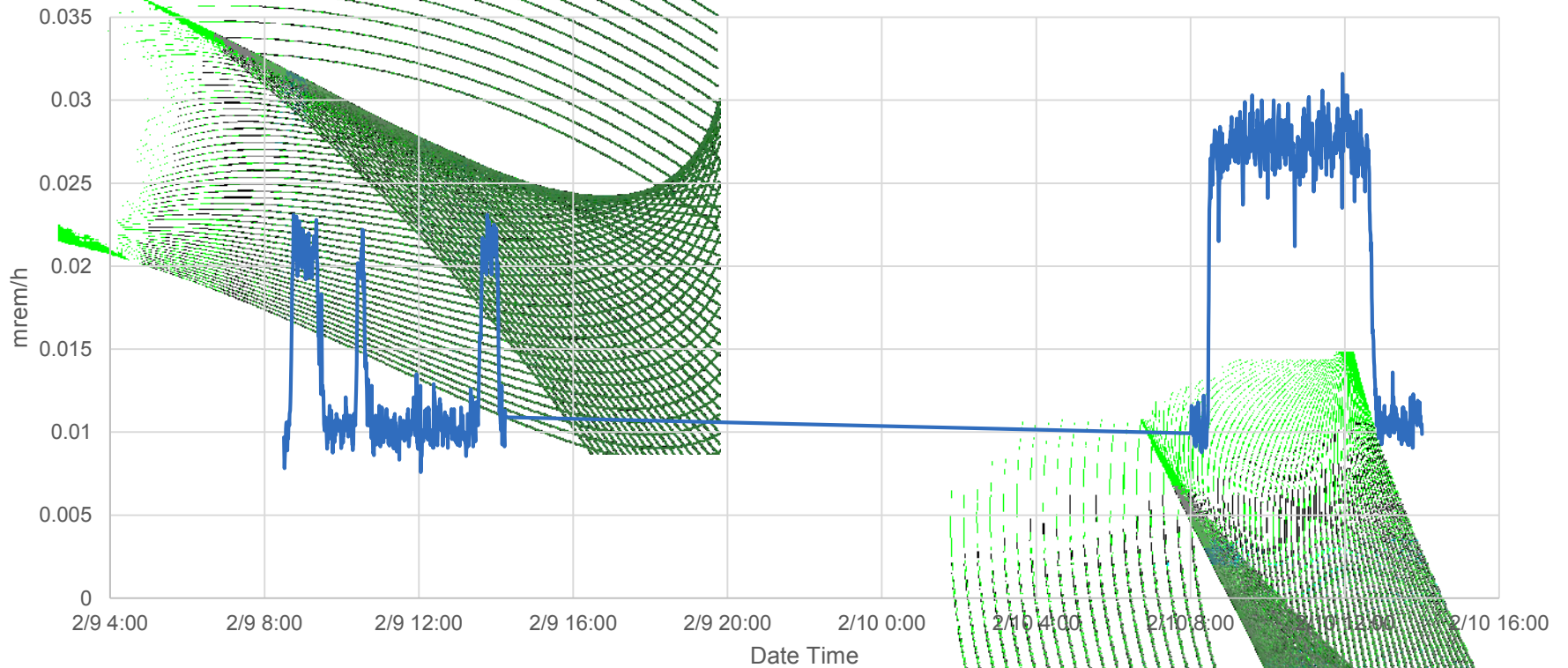


Skyshine



Skyshine

Bldg 8600 Dose Rate



Success



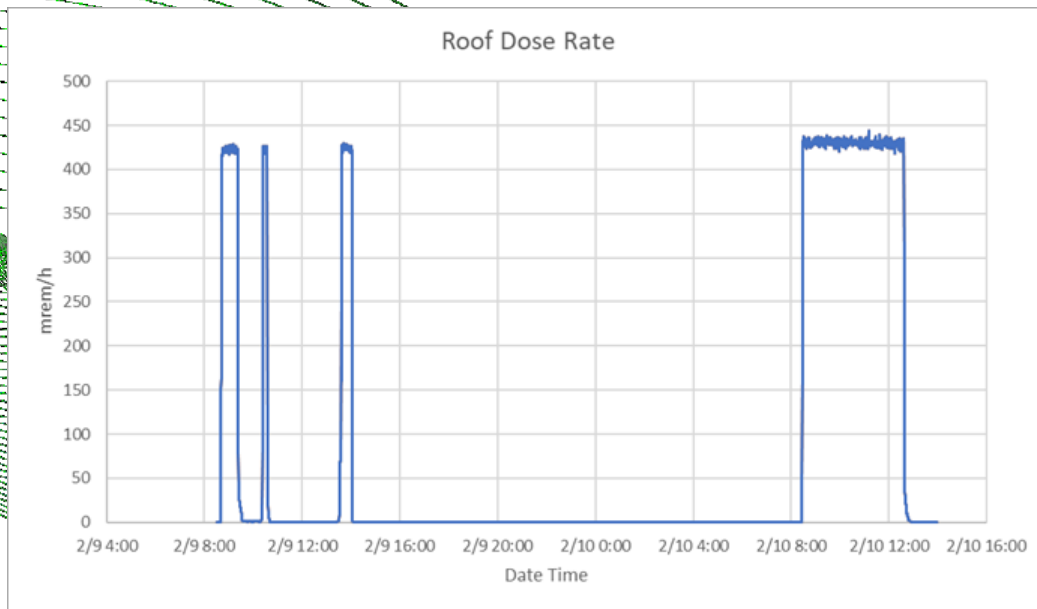
Summary of Radiological Conditions

- Projected person-rem: 2.9
 - Actual (estimate): 0.59 (31 employees)
- Dose rate anticipated: 500 rem/h at the surface plane
 - Actual: 50 rem/h at the surface plane
- Contamination limiting condition on RWP: 10,000,000 dpm/100cm² β-γ in SDER (excluding ³H), assuming mercury spallation products
 - Actual max contamination: 350,000 dpm/100cm² β-γ (Stainless steel, Be-7, Hg-203) top of segment 2; 9,400 dpm/100cm² in work area

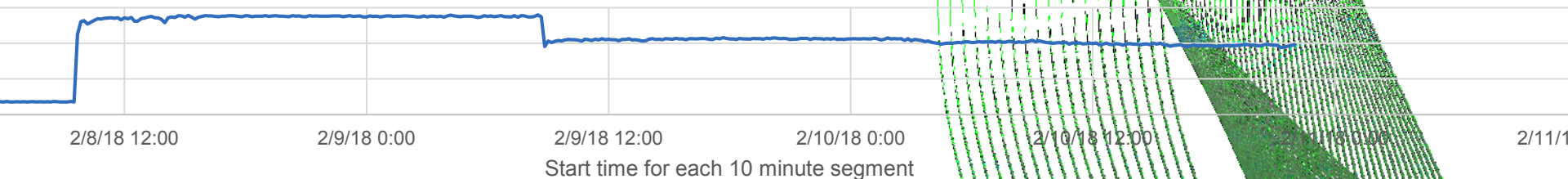
Finis!

But wait...

Instrument detector issues



Counts over 160 LPSD's at HYSPEC, 10 minute step size



Surprising Neutron Source

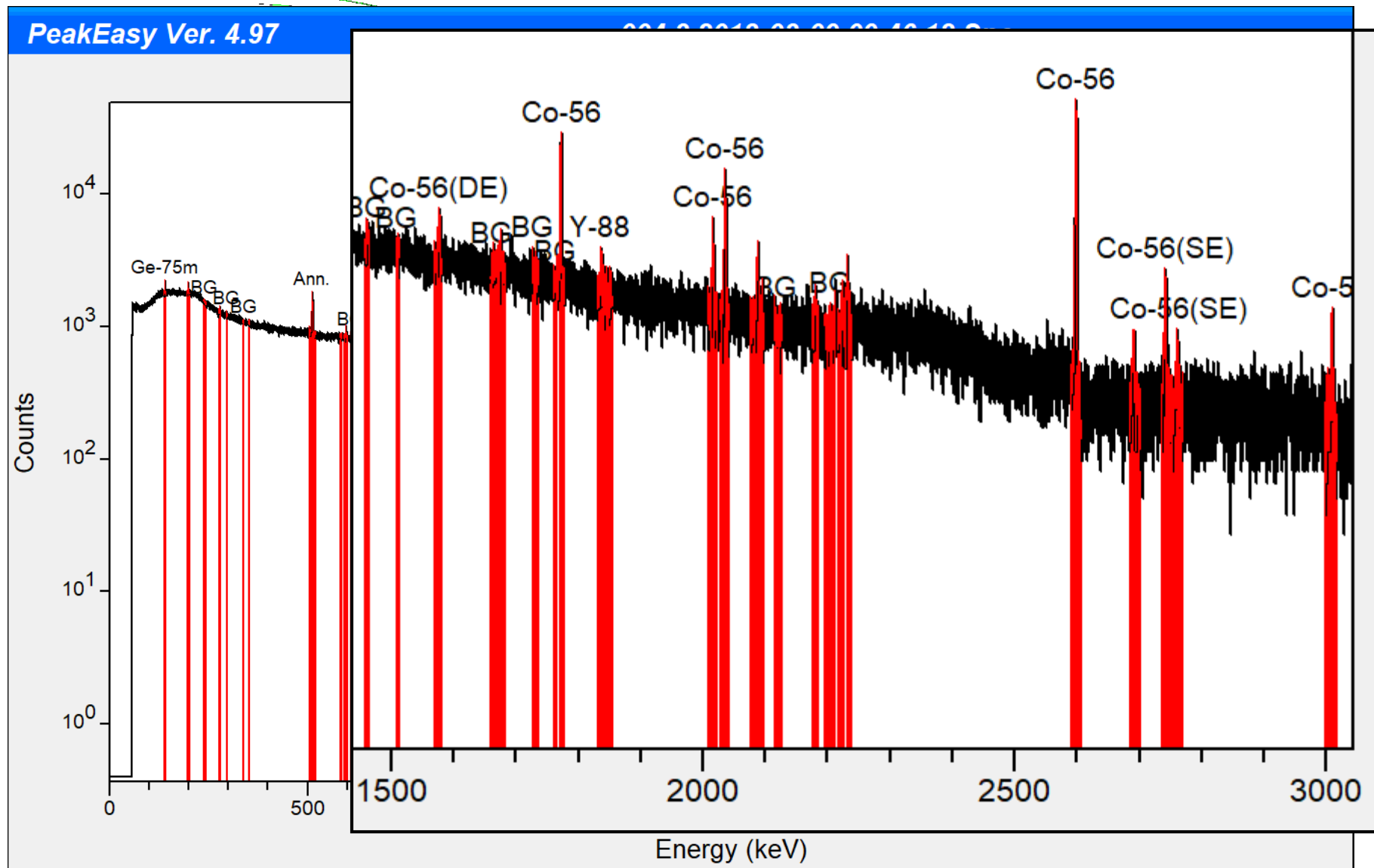
Start time for each 10 minute segment

Instrument detector issues

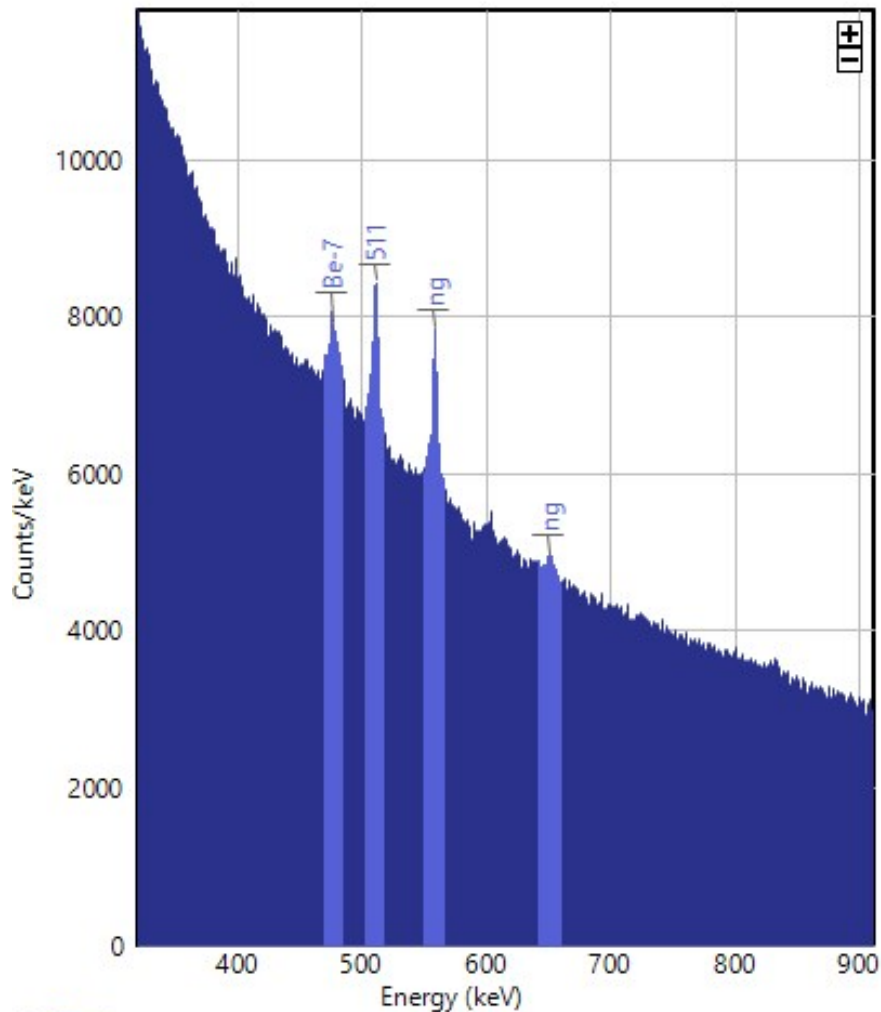
- Neutron source?
- Cosmic + Be?
- ${}^9_4\text{Be} + > 1.63 \text{ MeV } \gamma \rightarrow 1 {}^1_0\text{n} + 2 {}^4_2\text{He}$



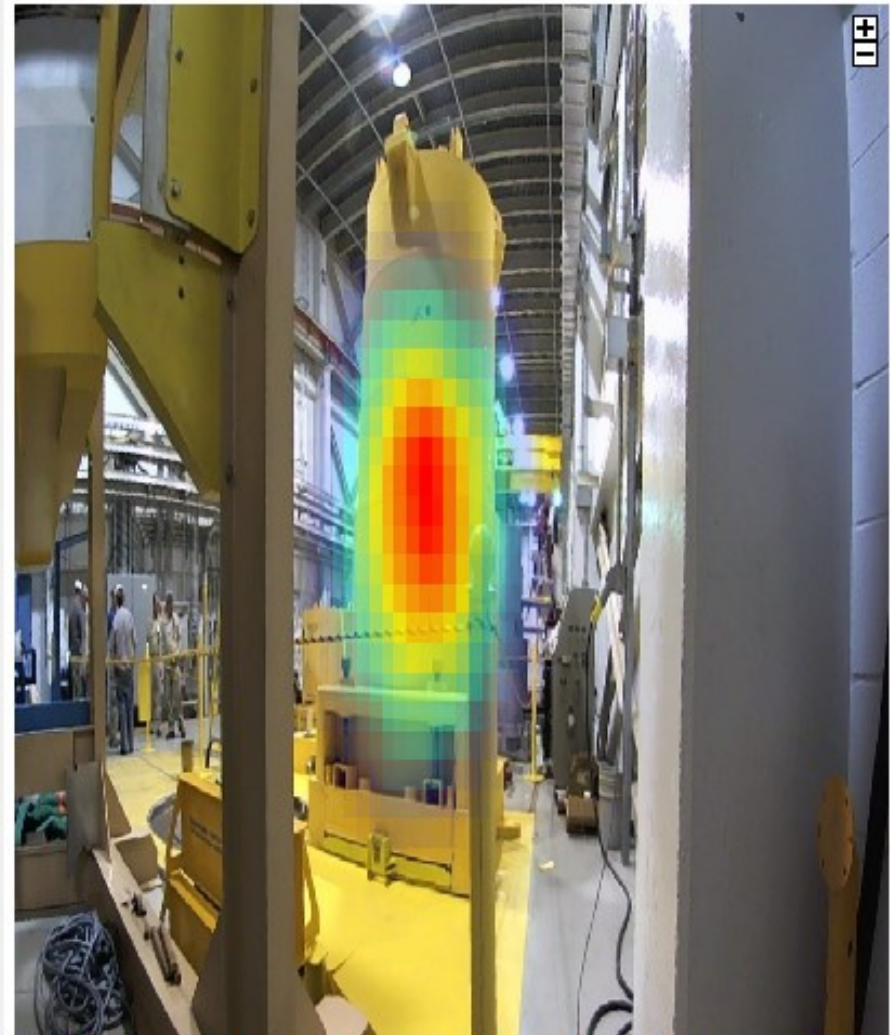
Instrument detector issues



Instrument detector issues



HED 11710442 Total Cts; 332669 Selected Cts; big_cask; 1:00:01



133169 Imaged Cts; N-16 (1.7-3 MeV); big_cask; 1:00:01

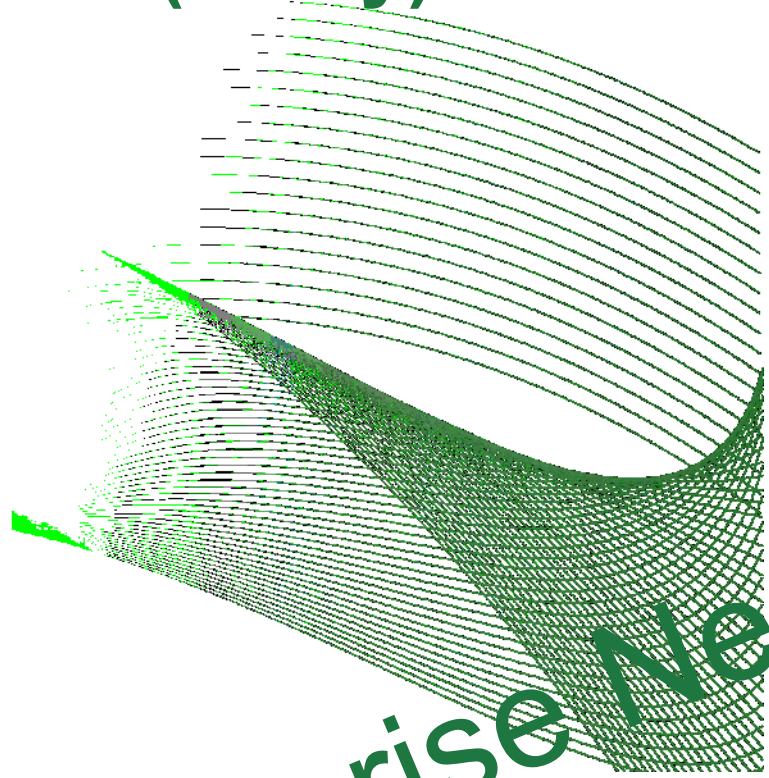
Instrument detector issues



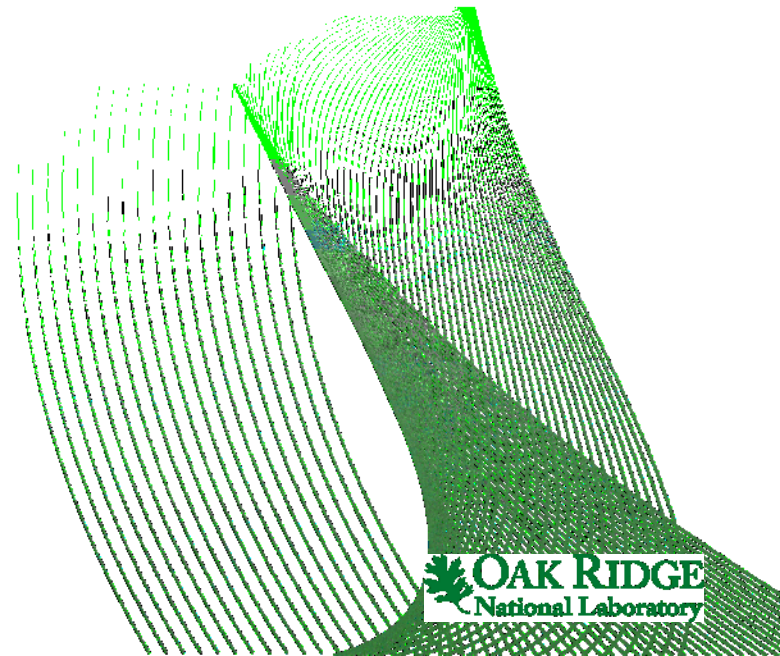
Finis (really)!

SNS stands for...

Finis (really)!



Surprise Neutron Source?



Thank you!

- SNS is managed by UT-Battelle, LLC, under contract DE-AC05-00OR22725 for the U.S. Department of Energy
- Irina Popova
- Franz Gallmeier
- Barry Winn