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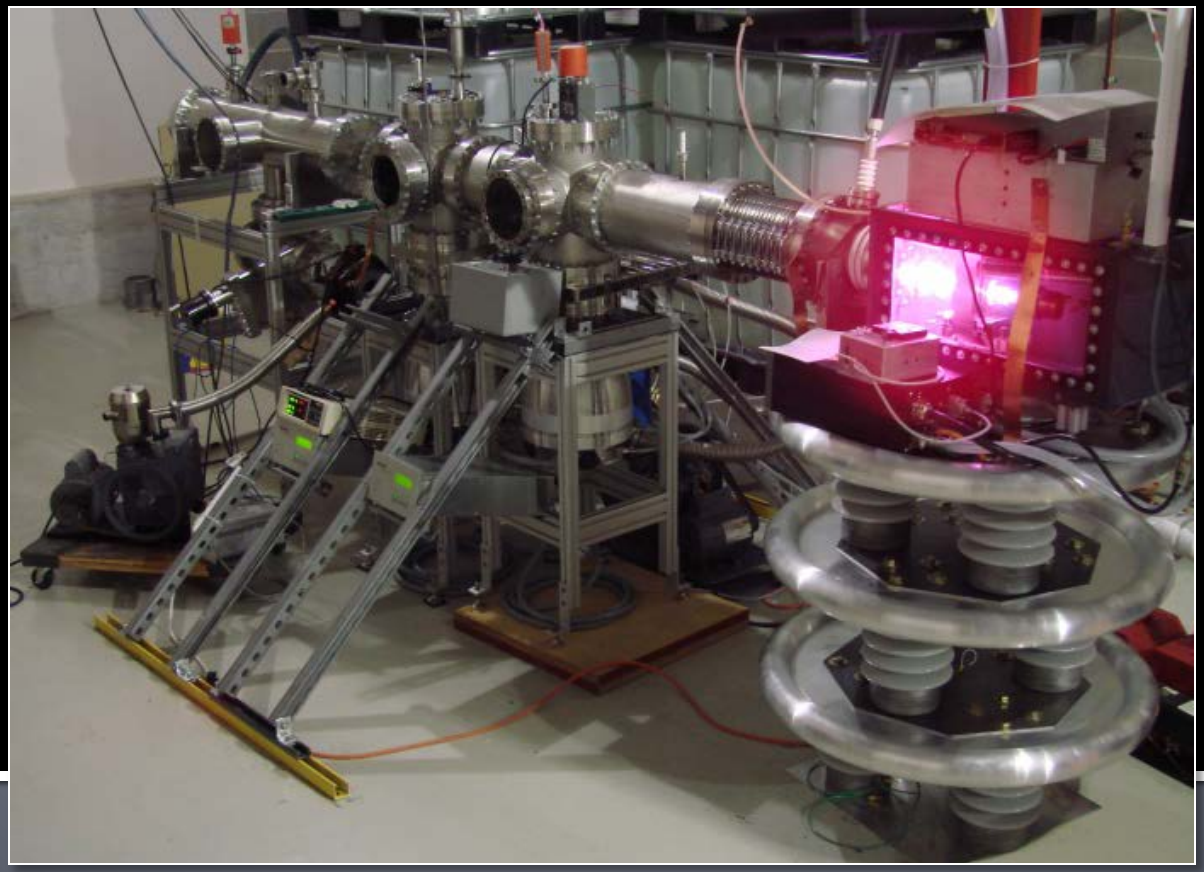

NRC Licensing and Project Update Meeting

February 23, 2012

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Introductions

Introductions

- Dr. Greg Piefer, SHINE Chief Executive Officer
- Dr. Vann Bynum, SHINE Chief Operating Officer
- Eric Van Abel, Nuclear Engineer
- Jim Freels, SHINE Licensing

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Agenda

- Open to Public
  - Licensing Discussion
    - License Application Approach
    - License Application Structure
    - License Application Content
  - Site Selection Update
- Closed Meeting
  - Project Update
    - Technology
    - Schedule

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License Application Approach

License Application Approach

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License Application Approach

- 10 CFR 50 for Production Facility
  - SHINE satisfies definition of Production facility
  - SHINE will not be a Utilization facility
- 10 CFR 30 for byproduct material
- 10 CFR 40 for source material
- 10 CFR 51 for NEPA requirements
- 10 CFR 70 for special nuclear material
- NUREG-1537
- Interim Staff Guidance for NUREG-1537 (currently draft form or under development)
- NUREG/CR-6410
- Other relevant parts of 10 CFR (19, 20, 21, 73, 74, etc.)

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License Application Approach

- Safety Analysis Report
  - References Aqueous Homogeneous Reactor (AHR) technology for fission process from draft ISG for NUREG-1537
  - SHINE will follow the general guidance for AHRs and adapt Sections for SHINE technology
  - SHINE will also generate appropriate Sections where SHINE technology has systems, structures and components not related to AHRs
  - References Radioisotope Production Facility guidance for separation processes from draft ISG for NUREG-1537, tailored for SHINE technology
- Environmental Report
  - References majority of draft Interim Staff Guidance for NUREG-1537, Section 12.12

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License Application Structure

License Application Structure

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License Application Structure

- Our License Application structure is different that the format suggested in NUREG-1537
  - NUREG-1537 has not been updated since February, 1996
  - Since 1996, NRC has provided guidance for electronic submittals and power reactors have submitted Combined License Applications (COLAs) using different structure to take advantage of electronic submittals
  - We propose using a License Application structure that is similar to that used for COLAs
  - The SAR will follow the NUREG-1537 guidance for format and content to the extent possible
  - We believe the efficiencies gained for SHINE and staff provide meaningful benefits for both

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License Application Structure

License Application Structure	Title
Part 1	General and Administrative Information
Part 2	Preliminary Safety Analysis Report (PSAR)
Part 3	Final Safety Analysis Report (FSAR)
Part 4	Environmental Report
Part 5	Technical Specifications
Part 6	Quality Assurance Program Description
Part 7	Proprietary and SUNSI Information
Part 8	Emergency Plan
Part 9	Security Plans
Part 10	Material Control and Accountability Plan
Part 11	Other Referenced Information

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License Application Content

License Application Content

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License Application Content

- Defined Terms for SHINE:
  - **Preliminary Design** – Initiates the process of converting concepts to a design appropriate for procurement or construction. The project scope is sufficiently defined to prepare a budget estimate. This stage of the design is complete when it provides sufficient information to support development of the performance baseline (key performance, scope, cost and schedule parameters).
  - **Final Design** – Completion of the design effort and production of all the approved design documentation necessary to permit procurement, construction, testing, checkout and turnover to proceed.

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License Application Content

Part 1, General and Administrative Information

General and Administrative Information		Construction Permit	Operating License
1.0	General Information	Content includes available information to address sections or provides reference to information location in Construction Permit application.	Content is updated with any new and relevant information or provides reference to information located in another portion of the Operating License application.
1.1	Applicant		
1.2	Description of Business or Occupation		
1.3	Organization and Management		
1.4	Requested Licenses and Authorized Uses		
1.5	Financial Qualifications		
1.6	Decommissioning Funding Assurance		
1.7	Foreign Ownership, Control, or Domination		
1.8	Restricted Data and Classified National Security Information		
1.9	References		

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License Application Content

Part 2, Preliminary Safety Analysis Report (PSAR)

Chapter 1	The Facility	Content consistent with NUREG-1537, draft ISG, and preliminary design.
1.1	Introduction	
1.2	Summary and Conclusions on Principal Safety Considerations	Describe any shared facilities, equipment and infrastructure if co-located with another licensed facility and make commitments regarding design to minimize impact to and from other licenses.
1.3	General Description of the Facility	
1.4	Shared facilities and equipment	
1.5	Comparison with other facilities	
1.6	Summary of operations	
1.7	Compliance with 1982 NWPA	N/A:SHINE does not anticipate having high level waste or spent nuclear fuel.
1.8	Renewal	Not Applicable
Chapter 2	Site Characteristics	Intent is to provide complete information per NUREG-1537 and draft ISG.
2.1	Geography and demography	
2.2	Nearby industrial, transportation and military facilities	
2.3	Meteorology	
2.4	Hydrology	
2.5	Geology, seismology and geotechnical engineering	

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License Application Content

Part 2, PSAR (continued)

Chapter 3	Design of Structures, Systems and Components	Description of the design criteria per NUREG-1537 and draft ISG to be applied to the facility structures, systems and components (fission systems and processing systems). Definition of safety-related SSCs that incorporates the information in the QAPD to include additional consequence criteria to protect against criticality, chemicals and worker exposures. Baseline design criteria for facilities that process SNM from 10 CFR 70.64.
3.1	Design Criteria	
3.2	Meteorological Damage	
3.3	Water Damage	
3.4	Seismic Damage	
3.5	Systems and Components	
3.5a	Aqueous Subcritical Assembly	
3.5b	Radioisotope Production Facility	
3.6	Research and development (as necessary)	Identification of any SSCs which require research and development, description and schedule of research and development program per 10CFR50.34(a)(8).

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Part 2, PSAR (continued)

Chapter 4	Fission Facility and Isotope Production Facility Description	
4a1	**Heterogeneous Reactor Description**	
4a2	**Aqueous Subcritical Assembly**	
4a2.1	Summary Description	
4a2.2	Target Solution Vessel (TSV)	
4a2.2.1	Target Solution	
4a2.2.2	Reactivity Control Mechanisms	
4a2.2.3	Neutron Moderator and Reflector	
4a2.2.4	Subcritical Multiplication Source	Content per NUREG-1537 and draft ISG based on preliminary design. Section headings specific to SHINE design and technology.
4a2.2.5	TSV Internals and Support Structures	
4a2.2.6	Neutron Multiplier	
4a2.3	Neutron Driver	
4a2.4	TSV and Light Water Pool	
4a2.5	Biological Shield	
4a2.6	Nuclear Design	
4a2.6.1	Normal Operating Conditions	
4a2.6.2	Target Solution Physics Parameters	
4a.2.6.3	Operating Limits	
4a2.7	Thermal-Hydraulic Design	
4a2.8	Gas Management System	
4a2.9	References	

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License Application Content

Part 2, PSAR (continued)

4b	**Radioisotope Production Facility Description**	
4b.1	Facility and Process Description	
4b.2	Biological Shield and Ventilation System	
4b.3	Radioisotope Extraction System	Content per NUREG-1537 and draft ISG based on preliminary design. Section headings specific to SHINE design and technology.
4b.4	Special Nuclear Material Processing and Storage	
4b.4.1	Processing of Irradiated Special Nuclear Material	
4b.4.2	Processing of Unirradiated Special Nuclear Material	
4b.5	References	

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Part 2, PSAR (continued)

Chapter 5	Fission and Radioisotope Production Cooling Systems	
5a1	**Heterogeneous Reactor Coolant Systems**	Not Applicable
5a2	**Aqueous Subcritical Assembly Cooling Systems**	Content per NUREG-1537 and draft ISG based on preliminary design. The Section headings will be based on SHINE design and technology.
5a2.1	Summary Description	
5a2.2	Primary Cooling System	
5a2.3	Secondary Cooling System	
5a2.4	Primary Cooling System Cleanup System	
5a2.5	Primary Cooling Makeup Water System	
5a2.6	Nitrogen-16 Control System	
5a2.7	Auxiliary Systems Using Primary Cooling	
5a2.8	References	
5b1	**Radioisotope Production Facility Cooling Systems**	
5b2	References	

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License Application Content

Part 2, PSAR (continued)

Chapter 6	Engineered Safety Features	
6a1	**Heterogeneous Reactor Engineered Safety Features**	Not Applicable
6a2	**Aqueous Subcritical Assembly Engineered Safety Features**	Content per NUREG-1537 and draft ISG based on preliminary design. The Section headings will be based on SHINE design and technology.
6a2.1	Summary Description	
6a2.2	Detailed Descriptions	
6a2.2.1	Confinement	
6a2.2.2	Containment	
6a2.2.3	Aqueous Subcritical Assembly Emergency Cooling System	
6a2.3	References	
6a2.4	Nuclear Criticality Safety in the Aqueous Subcritical Assembly	
6a2.4.1	Surveillance Requirements	
6a2.4.2	Technical Specifications	
6a2.5	References	
6b	**Radioisotope Production Facility Engineered Safety Features**	
6b.1	Summary Description	
6b.2	Detailed Descriptions	
6b.2.1	Confinement	
6b.2.2	Containment	
6.b.2.3	Emergency Cooling System	
6.b.3	Nuclear Criticality Safety in the Radioisotope Production Facility	
6.b.3.1	Criticality Safety Controls	
6.b.3.2	Surveillance Requirements	
6.b.3.3	Technical Specifications	
6.b.4	References	

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Part 2, PSAR (continued)

Chapter 7	Instrument and Control Systems	
7a1	**Heterogeneous Reactor Instrument and Control Systems**	Not Applicable
7a2	**Aqueous Subcritical Assembly Instrument and Control Systems**	Content per NUREG-1537 based on preliminary design. The Section headings will be based on SHINE design and technology and will reflect any new draft ISG information applicable to SHINE.
7a2.1	Summary Description	
7a2.2	Design of Instrumentation and Control Systems	
7a2.3	Fission Control Systems	
7a2.4	Fission Protection System	
7a2.5	Engineered Safety Features Actuation Systems	
7a2.6	Control Console and Display Instruments	
7a2.7	Radiation Monitoring Systems	
7b	**Radioisotope Production Facility Instrument and Control Systems**	
7b.1	Summary Description	
7b.2	Design of Instrumentation and Control Systems	
7b.3	Engineered Safety Features Actuation Systems	
7b.4	Processing Systems Instrumentation and Control	
7b.5	Control Console and Display Instruments	
7b.6	Radiation Monitoring Systems	
7b.7	References	

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License Application Content

Part 2, PSAR (continued)

Chapter 8	Electrical Power Systems	Content per NUREG-1537 based on preliminary design and will reflect any new draft ISG information applicable to SHINE.
8.1	Normal Electrical Power Systems	
8.2	Emergency Electrical Power Systems	
Chapter 9	Auxiliary Systems	Description of auxiliary systems and their functions and design criteria based on NUREG-1537 and preliminary design and will reflect any new draft ISG information applicable to SHINE.
9.1	HVAC Systems Outside Biological Shields	
9.2	Handling and Storage of Fuel	N/A: Addressed in SAR 4b.4
9.3	Fire Protection Systems and Programs	Description of auxiliary systems and their functions and design criteria based on NUREG-1537 and preliminary design and will reflect any new draft ISG information applicable to SHINE.
9.4	Communications Systems	
9.5	Possession and Use of Byproduct, Source and Special Nuclear Material	Summary description of need for licensing Byproduct, Source and Special Nuclear material.
9.6	Cover Gas Control	Description of auxiliary systems and their functions and design criteria based on NUREG-1537 and preliminary design and will reflect any new draft ISG information applicable to SHINE.
9.7	Other Auxiliary Systems	
9.8	Combustible Gas Control	
Chapter 10	Experimental Facilities and Utilization	Not Applicable
10.1	Explanation of why Chapter is not applicable	

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License Application Content

Part 2, PSAR (continued)

Chapter 11	Radiation Protection Program and Waste Management	Preliminary description of radiation protection program and waste management program and will reflect any new draft ISG information applicable to SHINE.
11.1	Radiation Protection	
11.2	Radioactive Waste Management	
Chapter 12	Conduct of Operations	
12.1	Organization	Description of construction aspects of conduct of operations.
12.2	Review and Audit Activities	
12.3	Procedures	
12.4	Required Actions	
12.5	Reports	
12.6	Records	
12.7	Emergency Planning	Brief discussion of Emergency Plan and Security Plan to be developed and general design concepts of the facility.
12.8	Security Planning	
12.9	Quality Assurance	Approved SHINE QAPD to be submitted with CP.
12.10	Operator Training and Requalification	Preliminary summary for operator training and qualification per NUREG-1537.
12.11	Startup Plan	Preliminary concepts for commissioning and startup testing per NUREG-1537.
12.12	Environmental Report	ER to be submitted as Part 3 of license application.

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License Application Content

Part 2, PSAR (continued)

Chapter 13	Accident Analyses	
13a1	**Heterogeneous Reactor Accident Analyses**	Not Applicable
13a2	**Aqueous Subcritical Assembly Accident Analyses**	General and bounding accident analyses focusing on potential consequences and general protective measures and will reflect any new draft ISG information applicable to SHINE.
13a2.1	Accident Initiating Events and Scenarios	
13a2.1.1	Maximum Hypothetical Accident	
13a2.1.2	Insertion of Excess Reactivity	
13a2.1.3	Reduction in Cooling	
13a2.1.4	Mishandling or Malfunction of Fuel	
13a2.1.5	Loss of Normal Electrical Power	
13a2.1.6	External Events	
13a2.1.7	Mishandling or Malfunction of Equipment	
13a2.1.8	Large Undamped Power Oscillation	
13a2.1.9	Detonation and Deflagration	
13a2.1.10	Unintended Exothermic Chemical Reactions Other than Detonation	
13a2.1.11	Facility System Interaction Events	
13a.2.2	Accident Analyses and Consequences	
13a.2.3	References	
13b	**Radioisotope Production Facility Accidents**	
13b.1	Accident Initiating Events and Scenarios	
13b.2	Accident Analyses and Consequences	
13b.3	References	

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License Application Content

Part 2, PSAR (continued)

Chapter 14	Technical Specifications	Description of development of Technical Specifications in this section. Part 5 of license application will identify and justify variables, conditions, or other items resulting from safety analysis that may significantly influence design.
Chapter 15	Financial Qualifications	Demonstrate financial ability to construct the facility per NUREG-1537.
15.1	Financial Ability to Construct a Facility	
15.2	Financial Ability to Operate a Facility	
15.3	Financial Ability to Decommission the Facility	
Chapter 16	Other License Considerations	Not Applicable
16.1	Prior Use of Components	
16.2	Medical Use of Facility	
Chapter 17	Decommissioning and Possession-Only License Amendments	Not Applicable - Decommissioning funding discussed in Chapter 15
17.1	Decommissioning	
17.2	Possession-Only License Amendment	
Chapter 18	Highly Enriched to Low Enriched Uranium Conversions	Not Applicable - Applies to conversion from HEU to LEU

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License Application Content

- Part 3, Final Safety Analysis Report (FSAR)
  - Submitted as part of the Operating License application
  - Follows same format as PSAR, but contains additional information from final design

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License Application Content

- Part 4, Environmental Report (ER)
  - The ER is based on the guidance of the draft ISG for NUREG-1537, Section 12.12
  - Not all elements of draft ISG are included based on large scope of information identified in draft ISG
  - As a result of work-to-date and findings, we believe the ER will lead to an EA based on our similarity to research reactors

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License Application Content

Part 4, ER

Environmental Report (based on NUREG-1537 draft ISG)		Construction Permit	Operating License (included for new or revised information)
Chapter 1	Introduction of the Environmental Report	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
1	Background Information		
1.1	Purpose and Need for the Proposed Action		
1.2	Applicable Regulatory Requirements, Permits, and Required Consultations		
Chapter 2	Proposed Action	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
2	Background Information		
2.1	Site Location and Layout		
2.2	Medical Isotope Production System		
2.3	Water Consumption and Treatment		
2.4	Cooling and Heat Dissipation Systems		
2.5	Waste Systems		
2.6	Storage, Treatment, and Transportation of Radioactive and Nonradioactive Materials		

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License Application Content

Part 4, ER (continued)

Environmental Report (based on NUREG-1537 draft ISG)		Construction Permit	Operating License (included for new or revised information)
Chapter 3	Description of the Affected Environment	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
3.1	Land Use and Visual Resources		
3.2	Meteorology, Climatology, and Air Quality		
3.3	Geology, Soils, and Seismology		
3.4	Water Resources		
3.5	Ecological Resources		
3.6	Historic and Cultural Resources		
3.7	Socioeconomics		
3.8	Human Health		

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License Application Content

Part 4, ER (continued)

Environmental Report (based on NUREG-1537 draft ISG)		Construction Permit	Operating License (included for new or revised information)
Chapter 4	Impacts of Proposed Construction, Operations, and Decommissioning	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
4.1	Land Use and Visual Resources		
4.2	Meteorology, Climatology, and Air Quality		
4.3	Geology, Soils, and Seismology		
4.4	Water Resources		
4.5	Ecological Resources		
4.6	Historic and Cultural Resources		
4.7	Socioeconomics		
4.8	Human Health		
4.8.1	Nonradiological Impacts		
4.8.2	Radiological Impacts		
4.8.3	Radiological Monitoring		
4.9	Waste Management		
4.10	Transportation		
4.11	Postulated Accidents		
4.12	Environmental Justice		

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License Application Content

Part 4, ER (continued)

Environmental Report (based on NUREG-1537 draft ISG)		Construction Permit	Operating License (included for new or revised information)
Chapter 5	Alternatives	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
5.1	No-Action Alternative		
5.2	Reasonable Alternatives		
5.3	Cost Benefit of the Alternatives		
5.4	Comparison of the Potential Environmental Impacts		
Chapter 6	Conclusions	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
6.1	Unavoidable Adverse Environmental Impacts		
6.2	Relationship Between Short Term Uses and Long Term Productivity of the Environment		
6.3	Irreversible and Irretrievable Commitments of Resources		
Chapter 7	List of Preparers	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).
Chapter 8	References	Environmental Report content per NUREG-1537 and draft ISG (to be submitted with CP).	Environmental Report content per NUREG-1537 and final ISG (to be submitted with OL, if needed).

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Part 5, Technical Specifications			
	Technical Specifications	**Construction Permit**	**Operating License**
	Based on ANSI/ANS 15.1-1990, The Development of Technical Specifications for Research Reactors	Identification of items from safety analysis that may be included in Technical Specifications.	Complete description of Technical Specifications.
Part 6, Quality Assurance Program Description			
	Quality Assurance Program Description		
	Based on Regulatory Guide 2.5 and ANSI/ANS 15.8-1995, Quality Assurance Requirements for Research Reactors.	Approved QAPD to be submitted for CP. The approved QAPD addresses all phases of design, construction, modification, operation and decommissioning.	Not Applicable
Part 7, Proprietary and SUNSI			
	Proprietary and SUNSI		
	License Application Part/Section/Information to be withheld from public disclosure.	Any information that is considered proprietary or SUNSI in the CP application will be included in this Part on a Part/Section basis.	Any information that is considered proprietary or SUNSI in the OL application will be updated/included in this Part on a Part/Section basis.

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Part 8, Emergency Plan				
	Emergency Plan		**Construction Permit**	**Operating License**
	Based on Regulatory Guide 2.6 and ANSI/ANS 15.16-2008, Emergency Planning for Research Reactors.		Not needed for Construction Permit. SAR Chapter 12 contains discussion of emergency planning.	A detailed Emergency Plan will be submitted per NUREG-1537 and final ISG to the extent of the hazards of the SHINE facility.
Part 9, Security Plans				
	Security Plans			
	Physical Security Plan	Based on Regulatory Guide 5.59, Revision 1.	Not needed for Construction Permit. Chapter 12 contains preliminary discussion of security as related to design and construction.	Security Plans will be developed per NUREG-1537, final ISG and any relevant security orders.
	Safeguards Contingency Plan			
	Guard Training and Qualification Plan			
Part 10, Material Control and Accountability Plan				
	MC&A Plan			
	Based on amount of special nuclear material to be licensed.		Not needed for Construction Permit. Chapter 12 contains brief discussion of Material Control and Accountability.	Complete MC&A Plan will be developed and submitted per 10 CFR 74.
Part 11, Other				
	11A Core Boring Logs		To be submitted with the CP	Not Applicable

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Site Selection Update

Site Selection Update

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Site Selection Update

- Considered a number of sites in multiple states
- Sites were narrowed down in Wisconsin:
  - Janesville, WI
    - Approximately 94 acres
  - Chippewa Falls, WI
    - Approximately 78 acres
  - Stevens Point, WI
    - Approximately 80 acres
- All potential site locations support the SHINE business plan for logistics, transportation, labor (proximity to large cities)

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Site Selection Update

- Numerous discussions held with local Economic Development staff for each potential site
- Reconnaissance level reviews performed for each site
- ANSI/ANS-15.7-1977 (W-1996), "American National Standard Research Reactor Site Evaluation" was referenced
- Natural phenomena hazards are preliminarily judged to be acceptable
- Hydrologic investigations started at two sites
- Ecological reviews started at two sites

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Site Selection Update

- Further discussion with local Economic Development staff and reviews of preliminary data suggested the preferred site to be Janesville, WI
- Additional work by the Janesville City Council to modify zoning and create a special tax district for the site location
- Those issues addressed at the Janesville City Council meeting on February 13, 2012
- Final agreement with City of Janesville in progress

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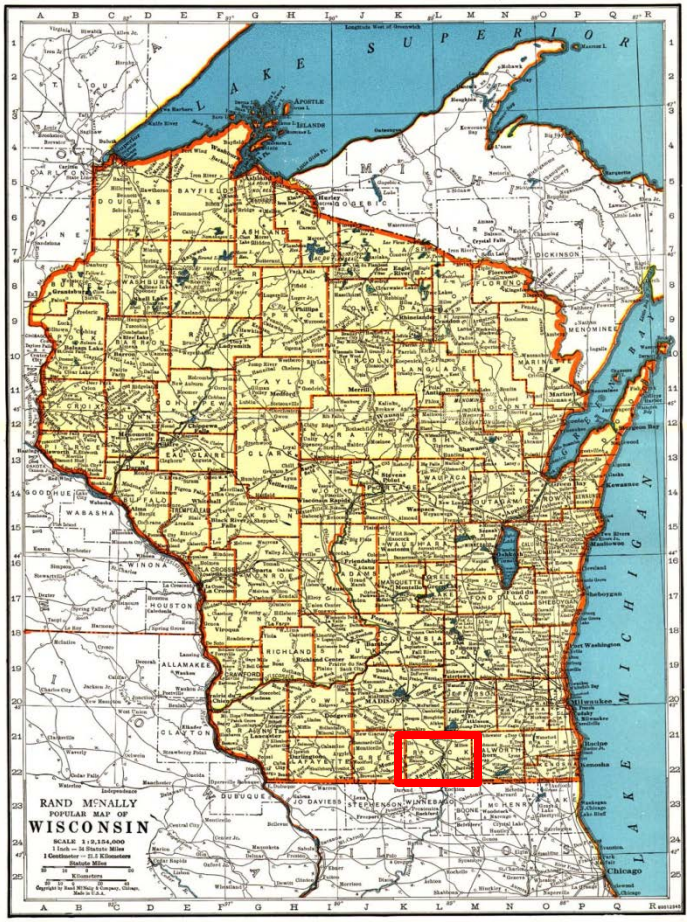
Site Selection Update

Janesville,
Rock County,
Wisconsin



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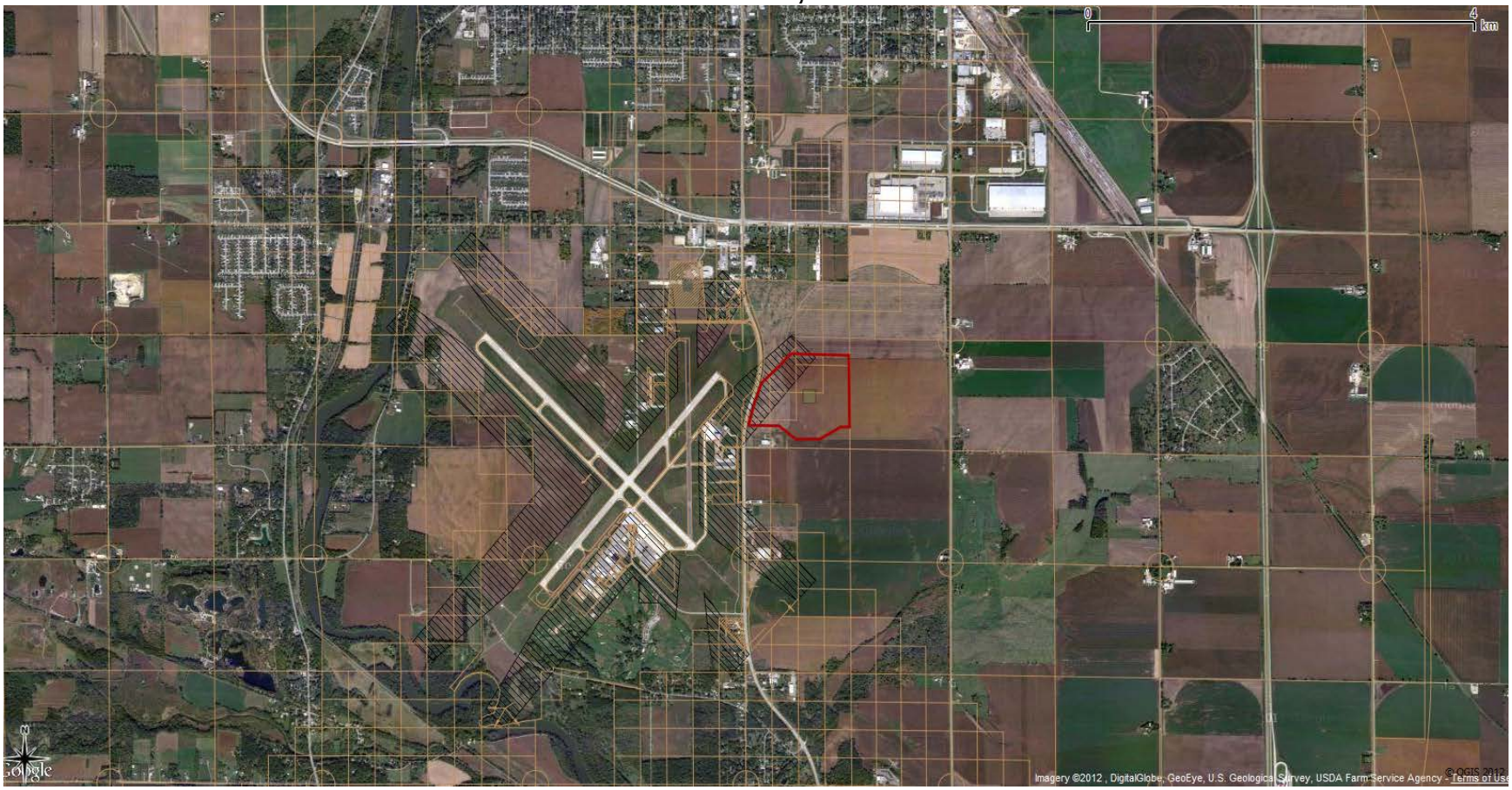
Site Selection Update

Janesville, WI Site



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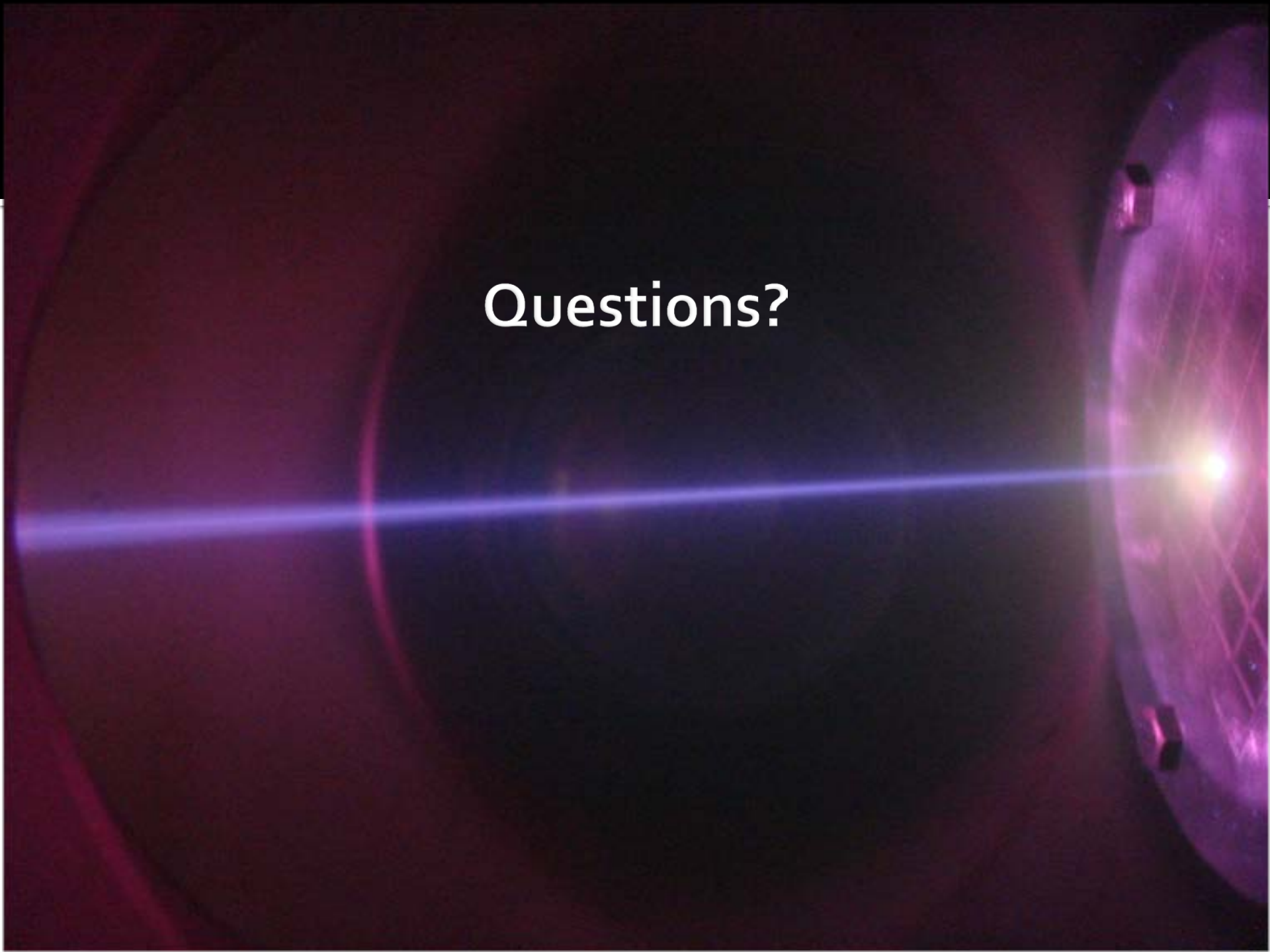
Questions?