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# NRC Staff Review of the Application for a License to Possess and Use Radioactive Material at the Mixed Oxide Fuel Fabrication Facility (MFFF)

**Public Meeting**
**May 10, 2011**

# What are our goals today?

**Continue a Dialog with the Affected Public**

- Discuss the NRC Staff's Safety Evaluation Report related to the License Application (LA) for the Mixed Oxide Fuel Fabrication Facility

- Status of Construction and NRC oversight

- Answer the public's questions

# NRC Staff Participation

- Project Manager (D. Tiktinsky)
- Integrated Safety Analysis (ISA) (K. Morrissey)
- Chemical Process Safety (J. Hammelman)
- Nuclear Criticality Safety (C. Tripp)
- Fire Protection (J. Downs)
- Quality Assurance and Management Measures (S. Atack)
- Civil/Structural Design (A. Chowdhury)
- Construction Inspection Status (W. Gloersen)
- Resident Inspectors (M. Shannon, B. Adkins)

# Outline for Discussion

- Licensing process and Safety Evaluation Report (SER) development
- Discussion of Technical Review
- Question and Answer Session
- Poster Session

# What is the NRC?

- **INDEPENDENT** Federal agency
- Reports directly to **CONGRESS**
- Regulatory **RESPONSIBILITY**

  - Safety and security reviews
  - Environmental reviews
  - Licensing reviews
  - Inspection
  - Enforcement

# NRC's Role

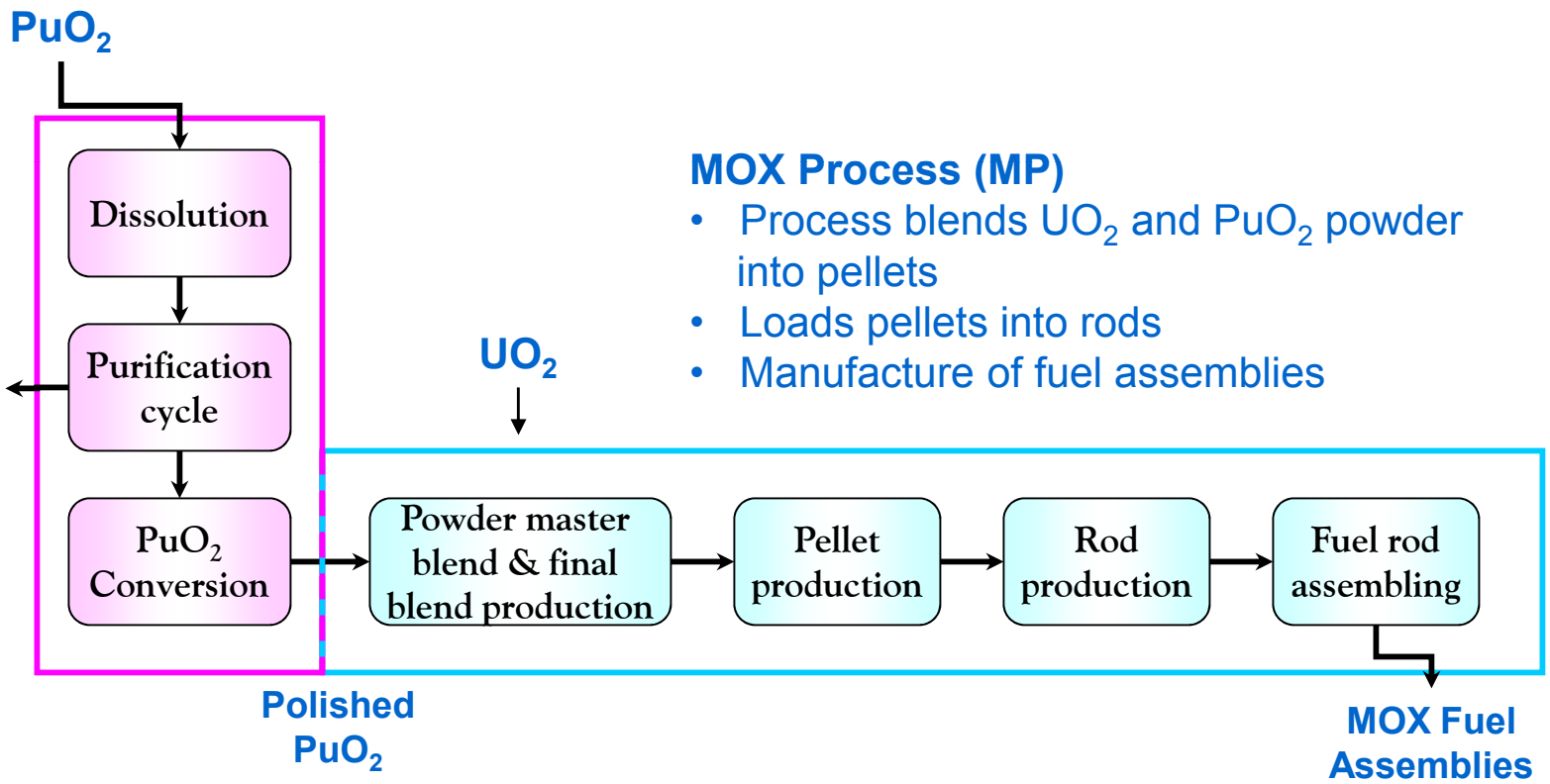
- All nuclear projects must meet strict safety, security, and environmental requirements

- After all regulatory requirements have been met, the license is issued

# MFFF Process Overview

**Aqueous Polishing (AP)**

- Primarily used to remove Ga & Am contaminants
- Also removes other impurities




**MOX Process (MP)**

- Process blends $UO_2$ and $PuO_2$ powder into pellets
- Loads pellets into rods
- Manufacture of fuel assemblies

# Licensing Process (Background)

- Staff SER on Construction Authorization Request and Construction Authorization issued (March 2005) (previously reviewed by ACRS)
- License Application (LA)/Integrated Safety Analyses Summary (ISAS) submittal (September 2006)
- Staff acceptance of LA for docketing (December 2006)
- Technical review (2006-2010)
- Advisory Committee on Reactor Safeguards (ACRS) reviewed SER (September 2010)
- Final SER on LA completed with no open items (December 2010)
- Licensing in litigation with Atomic Safety and Licensing Board (ASLB) (one contention accepted)
  - Hearing not yet scheduled
- Principal Structure System and Component (PSSC)(identified in CAR) verification (2014 estimated completion)
  - License will not be issued until this step is completed
- Issuance of license to possess and use radioactive material
- Operational readiness review
- Hot startup

# Safety Evaluation Report (SER) Development

- Staff used Standard Review Plan for MOX (NUREG-1718)

- Staff review included:
  - In-office reviews of MOX documents
  - Discussions with applicant
  - Requests for Additional Information (RAI)
  - Substantial communications between staff and applicant
  - Performing confirmatory calculations (if needed)
  - Detailed vertical slice review of high risk processes
  - Review of events identified by applicant and verification that other events were adequately considered
  - Considered items identified in ACRS Construction Authorization Request (CAR) SER letter

- No open items identified

# SER Organization

- **Outline of SER**
  - Chapter 1 - General Information
  - Chapter 2 – Financial Qualifications
  - Chapter 3 – Protection of Classified Matter
  - Chapter 4 – Organization and Administration
  - Chapter 5 – ISA
  - Chapter 6 – Criticality
  - Chapter 7 – Fire Protection
  - Chapter 8 – Chemical Safety
  - Chapter 9 – Radiation Safety
  - Chapter 10 – Environmental Protection
  - Chapter 11 – Plant Systems
  - Chapter 12 – Human Factors
  - Chapter 13 – Safeguards and Security
  - Chapter 14 – Emergency Management
  - Chapter 15 – Management Measures
  - Chapter 16 – Authorizations and Exemptions

# Technical Review Summary

- 70 meetings held between staff and applicant
- 100 in-office reviews by staff
- Over 600 Requests for Additional Information (RAIs) issued to applicant

# Request of Additional Information (RAI) Process Used in the Review

- Prepared on technical discipline specific basis
- Staff performed document reviews, in-office reviews, confirmatory calculations, etc.
- Staff met with applicant to assure understanding of Staffs' concerns
- Applicant prepared responses and met with staff prior to officially responding
- Applicant formally responds to RAI and revises LA/ISA summary as appropriate

# License Application Review Conclusion

- Staff completed SER with no open items
- Staff has received ACRS endorsement of SER
- License will not be granted until after PSSC construction verification completed
- Staff concluded that the MFFF License application meets the requirements of 10 CFR Part 70 as documented in the SER

# PSSC Construction Verification Process

# Background

- 10 CFR 70.23 (a)8 – requires that NRC verify that the construction of principal structures systems and components (PSSC's) (design basis) has been completed in accordance with the application (for plutonium processing facilities)
  - PSSCs were defined in the Construction Authorization Request
  - Verification is a joint NRC inspection, technical review and administrative review activity
  - Joint NMSS/Region II expert panel was formed to implement PSSC verification plans and activities

# What needs to be verified

- 53 PSSC's were defined in the Construction Authorization Request and approved by staff in the Construction Authorization (100% must be verified)

- PSSC's can be administrative controls, active engineered controls, passive engineered controls, or use of an approved item
  - PSSCs may include multiple safety functions and IROFS
  - PSSCs may support or be part of other PSSCs

- Verification of construction of a PSSC varies depending on nature of PSSC
  - Inspections (component specific or programmatic)
  - Procedure reviews
  - Other approvals (e.g., transportation package certification)

- Verification includes an assessment that the design basis safety function for each PSSC has been constructed in accordance with the application (through technical reviews and inspections)

# PSSC Verification Program Status

- IROFS have been prioritized for inspection purposes by staff using a risk-informed process
- Verification plan for each PSSC
- Performing inspections to support verification by resident and regional inspectors
- Documentation tracking system has been developed for all inspection activities
- Inspection activities to increase substantially as construction proceeds
- Multiple year verification process
- Must be successfully completed prior to license issuance

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# Technical Review Discussion

# ISA Summary Review

# Licensing Application Review

- ISA-Related Regulatory Requirements
  - Establish and maintain a Safety Program that demonstrates compliance with 10 CFR 70.61 performance requirements
    - Process safety information
    - ISA
    - Management Measures
  - Establish and maintain records that demonstrate compliance with the Safety Program
  - Maintain process safety information (PSI) that supports performance and maintenance of an ISA
    - Nuclear Safety Evaluations
    - Calculations and supporting documents (wiring, design, etc)

# Licensing Application Review (cont.)

- Conduct and maintain an ISA that is of appropriate detail for the complexity of the process, that identifies:
  - Radiological hazards;
  - Chemical hazards of licensed material and hazardous chemicals;
  - Facility hazards that could affect the safety of licensed materials;
  - Potential accident sequences internal to the facility and credible external events, including natural phenomena;
  - The consequence and the likelihood of occurrence of each potential accident sequence;
  - The methods used to determine the consequences and likelihoods; and
  - Each item relied on for safety, the characteristics of its preventive, mitigative, or other safety function.

# ISA Summary Review

- ISA Summary not part of license
  - Commitments and conditions for performing and maintaining ISA are in the license
- Changes to ISA Summary controlled by 70.72 change process
- Staff ISA Review
  - Based on approved ISA methods from CAR
    - Staff review assures acceptable implementation of the ISA methods
      - Hazops
      - Credibility
      - Accident sequences
      - Likelihoods and consequences
      - IROFS and management measures
  - Integrated review by technical staff

# Conclusion

- Staff provided review of ISA Summary to determine acceptability of meeting regulatory requirements for performing an ISA and meeting 70.61 requirements

- Majority of the determination of acceptability performed by the technical staff

- Verification of the construction of key IROFS and associated safety functions will be performed through inspection

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# Chemical Process Safety

# Objective

*Chemical Safety*

- Assure that chemical hazards associated with licensed material operations are identified and managed
- Assure chemical risks from non-licensed material operations do not threaten nuclear material operations
- Assure necessary regulations and codes are satisfied

# Findings

*Chemical Safety*

- Most of the chemical hazards are in aqueous processing operations
- Principal hazards
  - Hydrogen fires and explosions
  - Solvent fires and explosions
  - Other chemical reactions

# Conclusions

*Chemical Safety*

## MOX Services

- Adequately identified chemical hazards
- Adequately assessed chemical hazard accidents and their consequences
- Proposed adequate controls for management of chemical risks including use of defense-in-depth considerations

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# Nuclear Criticality Safety

# Nuclear Criticality Safety (NCS)

- License application review
  - Commitments to establishment of NCS Program (consistent with NUREG-1718, ANS-8 standards)

- ISA review
  - Nuclear Criticality Safety Evaluations (NCSEs)
  - Calculation documents
  - Supporting technical documents (e.g., drawings, P&IDs, technical notes, etc.)

# Nuclear Criticality Safety (NCS)

- ISA must demonstrate:
  - Subcriticality under normal and credible abnormal conditions (including margin)
  - *Double contingency principle*: at least two independent, unlikely, and concurrent changes in process conditions before criticality is possible
  - All credible accident sequences resulting in criticality must be highly unlikely

# Nuclear Criticality Safety (NCS)

- Basis for NCS:
  - Aqueous Polishing (AP):
    - Favorable geometry solution-bearing equipment (columns, piping, slab & annular tanks, drip trays, etc.)
    - Process controls (temperature, reagents) to prevent formation of more reactive fissile material forms
    - Sampling prior to transfer to unfavorable geometry

# Nuclear Criticality Safety (NCS)

- MOX:
  - Enrichment Control
  - Moderation control on powder/pellets/rods/assemblies:
    - Limitation on additives, external lubricants (e.g., pump oil)
    - Sealed fissile material containers and gloveboxes
    - Limitations on solution and liquid handling
    - Non-hydrogenous firefighting agents
  - Mass control by IROFS scales
- Auxiliary:
  - Low mass/concentration in ventilation, waste drums, and pneumatic transfer by non-destructive assay (NDA)

# Conclusions (NCS)

- MOX Services
  - Established NCS Program meeting industry standards and NRC guidance that:
    - Demonstrated all processes are subcritical under normal and credible abnormal conditions
    - Demonstrated all processes are doubly contingent
    - Demonstrated all criticality accident sequences will be highly unlikely

# Fire Protection

# Objectives

*Fire Protection*

- Are MFFF's fire protection commitments adequate to meet the regulations?
  - Do the equipment and facilities protect health and minimize danger to life or property (10 CFR 70.23(a)(3))?
  - Does the ISA demonstrate compliance with safety performance requirements (10 CFR 70.61)?
  - Does the design provide for adequate protection against fires and explosions (10 CFR 70.64(a)(3))?

# Findings

*Fire Protection*

- License application review
  - Commitments for fire protection program were consistent with NUREG-1718
  - Commitments for fire protection related administrative controls were consistent with NUREG-1718
  - Design of fire protection features and systems were consistent with NUREG-1718
  - MFFF committed to following applicable National Fire Protection Association (NFPA) standards

# Findings (cont'd)

*Fire Protection*

- ISA review
  - Fire Hazards Analysis (FHA)
  - Potential fire events
  - Fire protection IROFS
- FHA was performed consistent with Appendix D, NUREG-1718

# Conclusions

*Fire Protection*

- MFFF's proposed equipment and facilities are adequately described and will protect health and minimize danger to life or property.

- MFFF's ISA demonstrates a reasonable level of assurance that adequate fire protection will be provided and maintained to meet the safety performance requirements.

- MFFF's fire protection-related IROFS and defense-in-depth controls will provide adequate protection against fires and explosions.

# Quality Assurance and Management Measures

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# Management Measures and Quality Assurance

- Quality Assurance commitments described in MOX Quality Assurance Program Description (QAPD)
- Management Measures described in Chapter 15 of the License Application
- Both were evaluated against criteria in NUREG 1718

# Management Measures

- *Management measures* are the functions performed by the licensee, generally on a continuing basis, that are applied to items relied on for safety (IROFS), to ensure the items are available and reliable to perform their functions when needed. Management measures include (1) Configuration management, (2) Maintenance, (3) Training and qualifications, (4) Procedures, (5) Audits and Assessments, (6) Incident Investigations, (7) Records Management, and (8) Other QA Elements.

# Quality Assurance

- MOX is required to establish and implement a quality assurance program that meets the requirements of Appendix B to 10 CFR Part 50.

- MOX committed to comply with ASME NQA-1-1994, as revised by 1995 addenda

# Management Measures and Quality Assurance

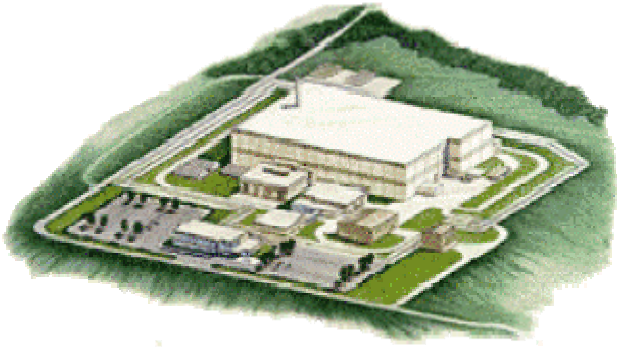
- The staff concluded that the MOX license application and QAPD
  - Satisfy the acceptance criteria identified in Chapter 15 of NUREG 1718
  - Will provide reasonable assurance that all IROFS perform their designated safety functions and are continually available and reliable to perform their safety function

# Civil/Structural Design

# Objective

*MFFF Structure Safety Review*

To ensure that the design bases and design of the principal civil structure provides reasonable assurance of protection against natural phenomena and the consequences of potential accidents



# Findings

*Principal Civil Structure Safety Review*

- Principal civil structure has been designed for Seismic Category–1 design loadings—normal, severe, and extreme environmental loads

- Hazards included as design bases for principal civil structure
  - Seismic
  - High wind
  - Tornado
  - Flooding
  - Snow
  - Explosion of nearby facilities and transportation routes
  - Tornado and wind generated missiles

# Conclusions

*Principal Civil Structure Safety Review*

- MOX Services
  - Adequately determined design bases for design of principal civil structure
  - Used NRC-accepted codes and standards to design principal civil structure
  - Used acceptable design methodology
  - Used NRC-accepted design load combinations
  - Acceptably demonstrated that the principal civil structure will be able to maintain its intended safety functions at $1\times10^{-5}$/year failure probability or better, consistent with guidance in NUREG–1718 through a probabilistic performance evaluation

- Design of the principal civil structure complies with the baseline design criteria in 10 CFR 70.64

# Construction Inspection Status

# MOX Quick Facts

| Structure, System, Component | Total | Installed (as of 3/31/2011) |
|---|---|---|
| Reinforced Concrete | 170,000 cubic yards | 87,893 cubic yards |
| Reinforcing Steel | 28,049 tons | 15,965 tons |
| Cable Tray | 47,000 linear feet | 1,000 linear feet |
| Power/Control Cable | 7,000,000 linear feet | 0 linear feet |
| Process Piping (Aqueous Polishing) | 50,903 linear feet | 3,584 linear feet |
| Gloveboxes | 351 | 2 |
| AP Processing Tanks | 74 | 52 |

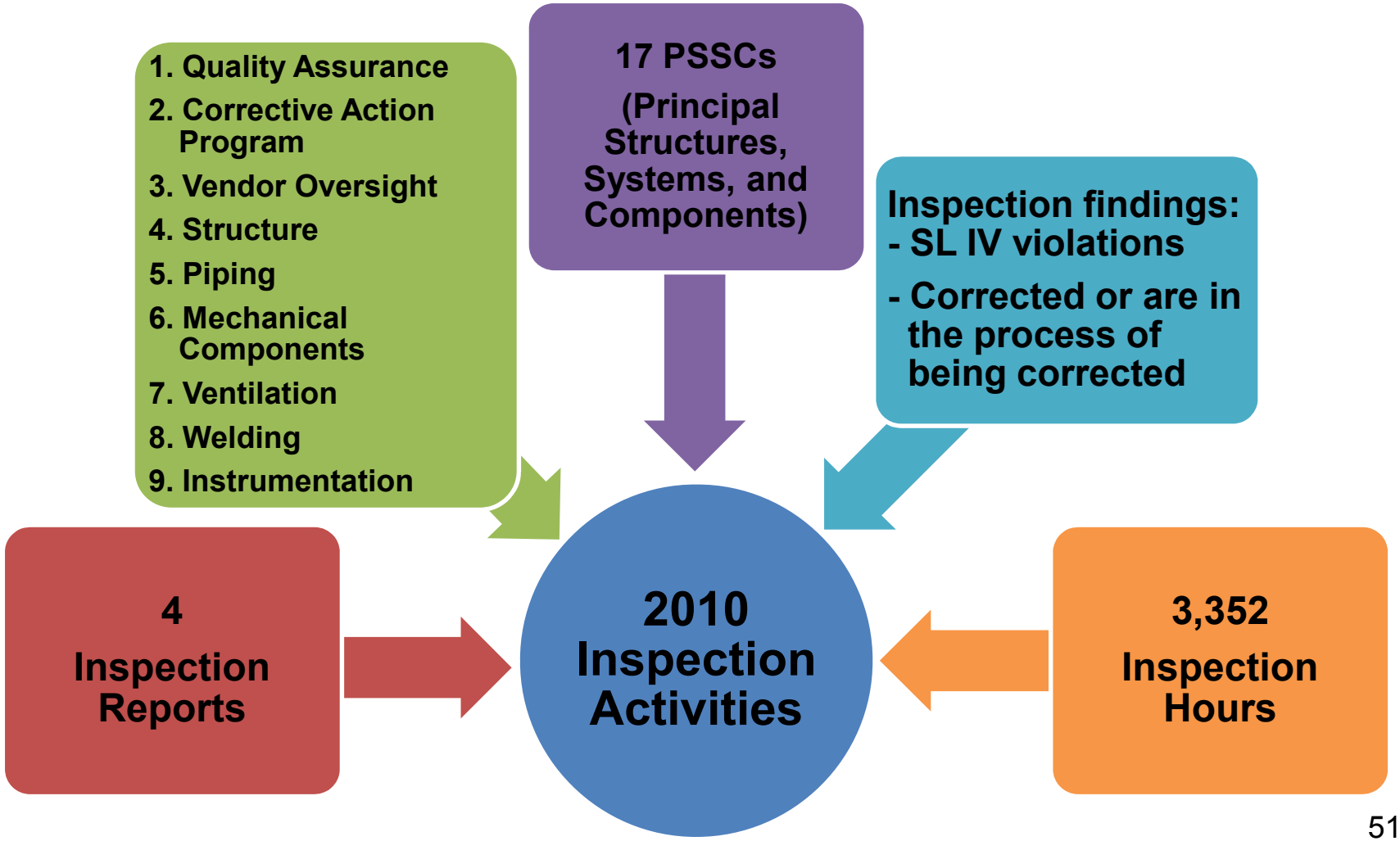
# Inspection Program Overview

- Resident Inspector Program
  - Two Resident Inspectors

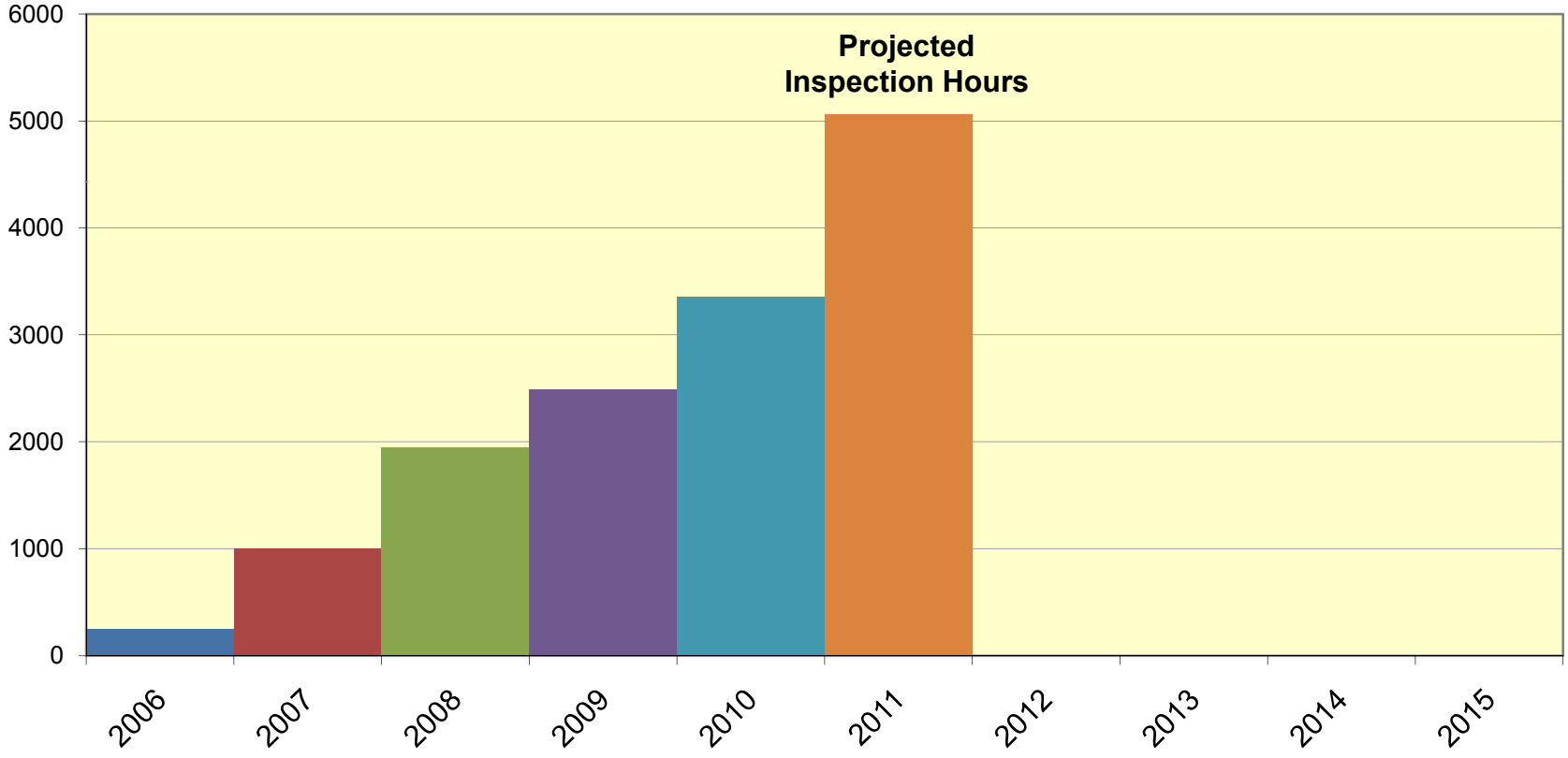
- Quality Assurance (QA) Inspections
  - Design Control
  - Corrective Action Program (CAP)
  - Control of Materials, Equipment, and Services
  - Supplier/Vendor Oversight

- Construction Inspections
  - Geotechnical and Civil
  - Mechanical (Special Processes – welding)
  - Electrical (Instrumentation and Controls)

# Inspection Program Overview (continued)



# Inspection Hours Expended at MOX FFF



# Summary

- SER issued in December 2010
- License will not be granted until after PSSC verification completed
- Staff concluded that the MFFF License application meets the requirements of 10 CFR Part 70 as documented in the SER
- Public version of SER can be found in the NRC's ADAMS system
- NRC MOX Licensing website
  - Information on licensing, public involvement, regulations, and related documents

www.nrc.gov/materials/fuel-cycle-fac/mox/licensing.html

# Questions?