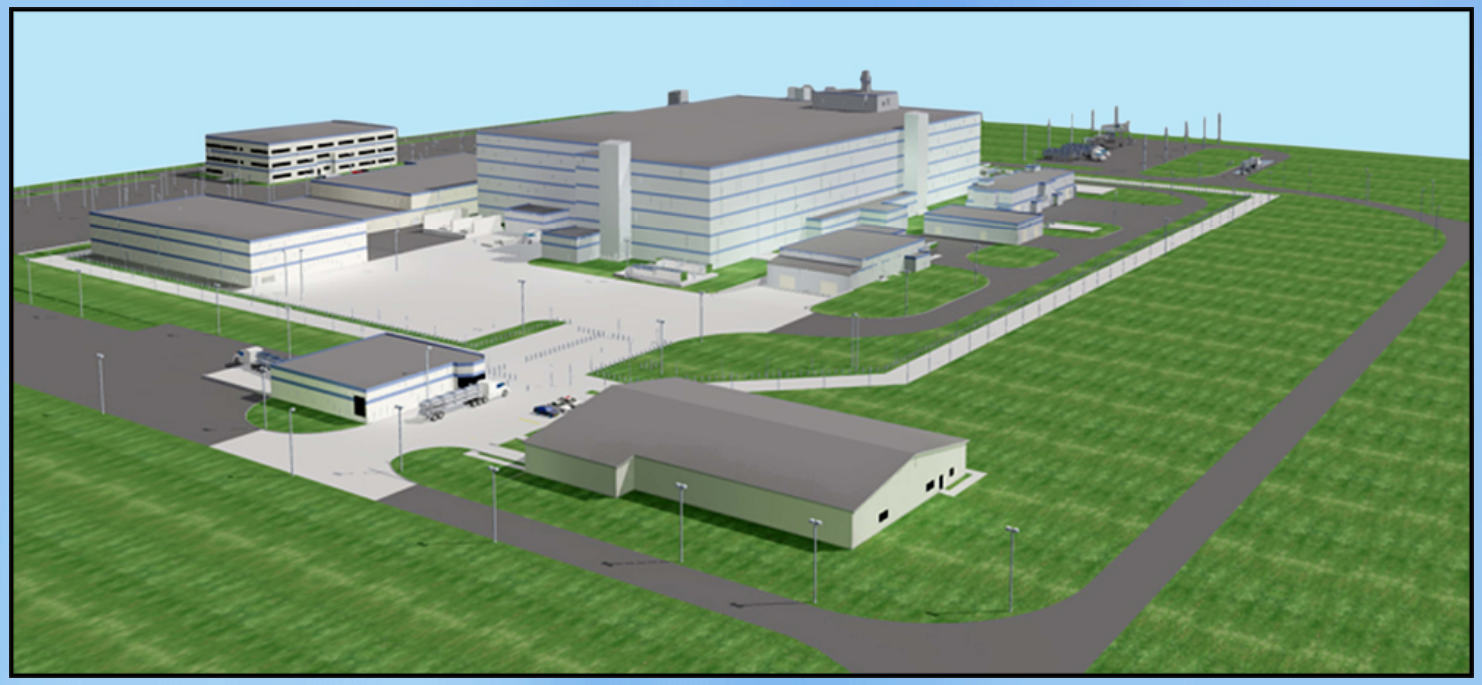
MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

NRC Fuel Cycle Information Exchange



Walt Elliott
Vice President, Shaw Areva MOX Services, LLC

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Agenda

- Project Overview
  - Background
  - Construction Update
- Lessons learned

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Project Overview

MOX Safety Fuels the Future

What is MOX?

- **Mission**
  - Convert 34 metric tons of weapons-grade plutonium to mixed oxide (MOX) fuel for use in commercial power reactors
- **Positive Impact**
  - Removes many warheads from the nuclear arsenal
  - Eliminates $500 million/year in security costs
  - Provides clean, carbon free energy that offsets over $21 billion in imported oil costs at $50/barrel

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

MOX Fuel Fabrication Facility

Plutonium handling, fuel processing, and fuel fabrication operations

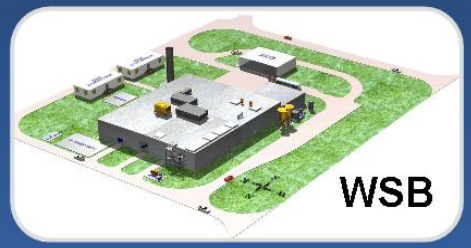
- Const. Start: 1 Aug 07
- Size: 600,000 ft^2
- Output: 151 Fuel Assemblies/yr

Pu Disposition

Pit Disassembly and Conversion Facility

Nuclear weapon pits disassembled and converted to MFFF feedstock

- Const. Start: 2011
- Size: 280,000 ft^2
- Process: 3.5 metric tons/yr



Waste Solidification Building

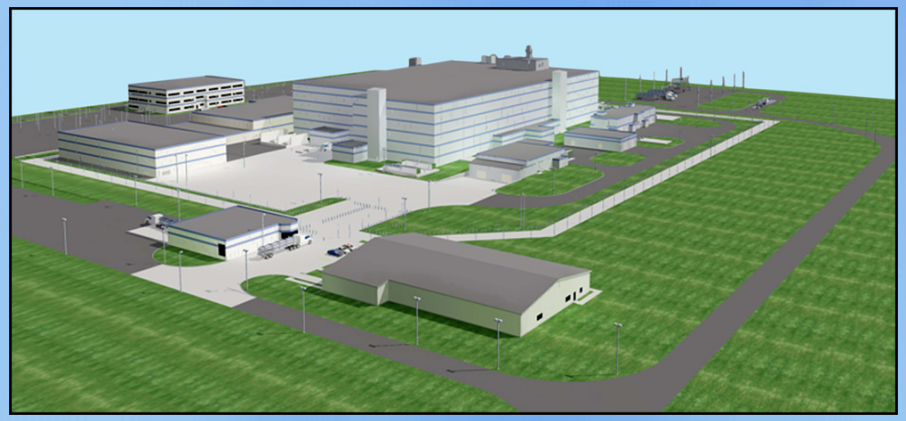
Processes MFFF/PDCF wastes into safe solid waste forms

- Const. Start: 2009
- Size: 28,000 ft^2
- Process: 555,000 gals/yr

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

MFFF & Support Buildings



Construction Statistics

Concrete:	**170,000 cubic yards**	**Cable tray:**	**47,000 linear feet**
Reinforcing steel:	**35,000 tons**	**Power/control cable:**	**3,600,000 linear feet**
Buildings:	**600,000 square feet**	**Process piping:**	**>85 miles**

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

MOX Staffing

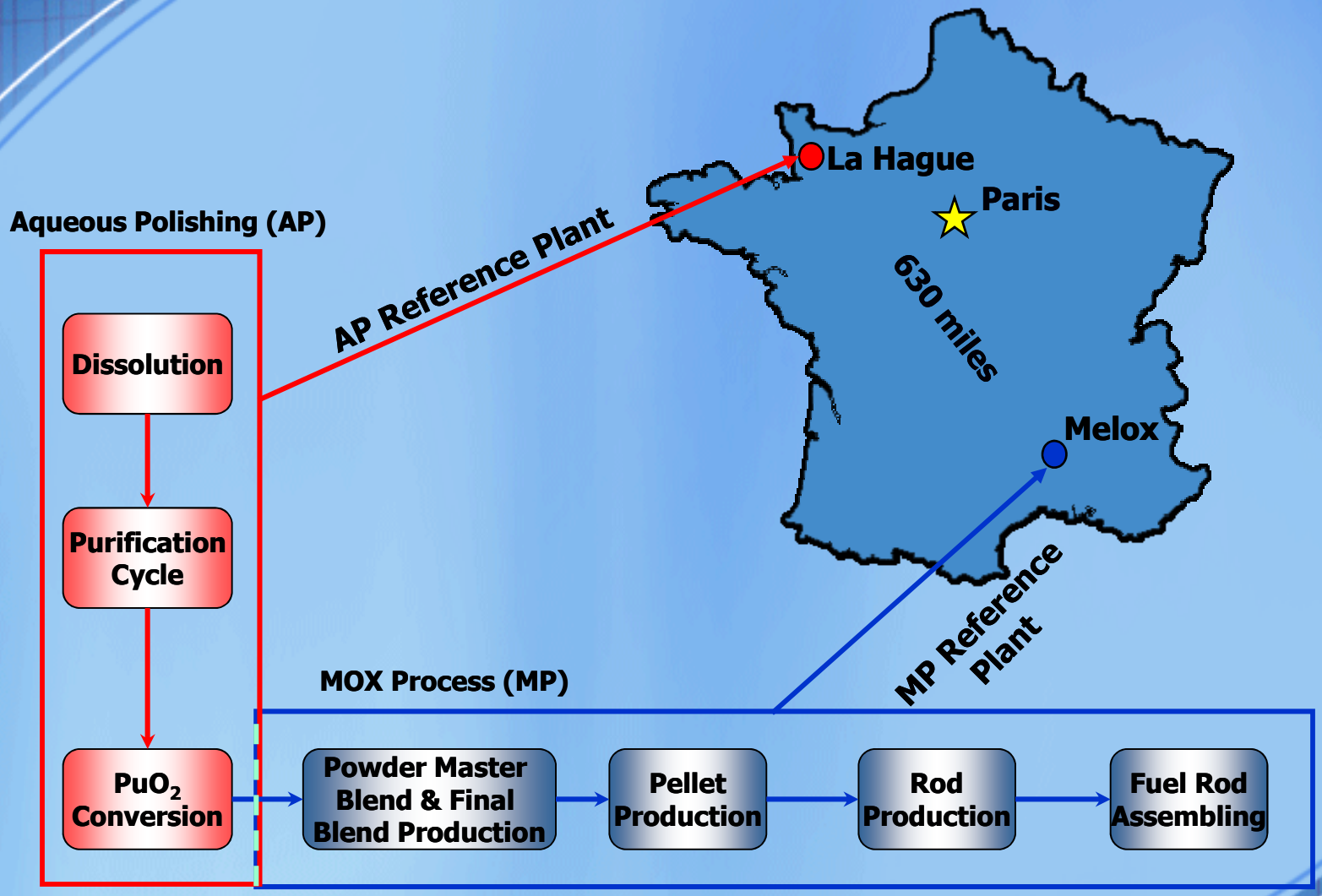
MOX Services	**1037**
Construction	**499**
MOX Project Total Employment	**1,536**

As of May 27, 2009

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

MFFF Reference Plants



MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Construction Update

MOX Safety Fuels the Future

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

August 1, 2007

Start of Construction

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Material Quantities Installed:

Office Space (Completed)	262,500 square feet
Office Space (In Process)	78,000 square feet
Structural Concrete	52,028 cubic yards
(unreinforced)	47,538 cubic yards
Rebar	9,845 tons
Embedded Plates	10,535 plates
Embedded Pipe	5,177 feet

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Base Mat Placement

Piping Placement

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Wall Placements

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Process Unit Assembly

110,000 ft^2
Assembly, Startup & Test
Office Space for 100

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Lessons Learned

From a nuclear industry viewpoint, it is imperative that there is a continual sharing of lessons learned in nuclear construction

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Lessons Learned Sources

- NRC inspections
- Corrective action program
- Audits, surveillances, and assessments
- Construction experience
- Vendor interactions
- Industry experiences
- Lessons learned

Inspection Summary

- Resident inspector since Oct 2006
- Inspection reports
  - 2006 – 1 inspection report
  - 2007 – 5 inspection reports (4 quarterly, QA inspection)
  - 2008 – 5 inspection reports (4 quarterly, vendor)
  - 2009 – 4 inspection reports (1 quarterly, corrective action, vendor, concrete void)

MOX Lessons Learned

- Staffing
- Vendors
- Inspection support
- Quality of engineering, construction, and vendor documentation
- General observations

MOX Lessons Learned
Staffing

- **Staffing**
  - **Location**
  - **Continuity**
  - **Location**
  - **Experience**
  - **Recruitment and retention**

MOX Lessons Learned Staffing

- **Workforce Characteristics**
  - **Experienced professionals are limited**
  - **Experienced professionals (for the most part) are within 2 to 5 years of retirement**
  - **Potential requirement for 25,000 + new nuclear professionals over the next 5 years**

MOX Lessons Learned Staffing

- Mitigation Strategy
  - Gateway Program
    - Focus on entry level hiring
    - Aggressive Scholarships / Internships Programs
    - Expanded on site opportunities for advanced education
    - Enhanced community involvement
  - Training classes
  - Lessons learned program
  - Mentoring

MOX Lessons Learned
Vendors

- **Vendors**
  - **Availability**
  - **Recent experience**
  - **Program implementation**
  - **Specifications compliance**

MOX Lessons Learned Vendors

- Supplier Characteristics
  - Experienced, active suppliers are limited
  - Procurement volume within the industry is insufficient to drive new program and people investments
  - Large suppliers are the exception

MOX Lessons Learned Vendors

- **Mitigation Strategy**
  - **Enhanced qualification audits that go beyond the supplier's QA manual to implementation practices**
  - **Utilization of resident engineer and QC project personnel while fabrication is in progress to identify issues early**
  - **Development of partnership / mentoring relationships with key suppliers**

MOX Lessons Learned
Inspection Support

- **Inspection support**
  - **Experience of staff**
  - **Construction versus operations**
  - **Size and experience level of NRC inspection team**
  - **Vendor experience**

MOX Lessons Learned
Inspection Support

- **Mitigation strategy**
  - **Dedicated staff**
  - **Documented inspection lessons learned (logistics to technical)**
  - **Enhanced surveillances**
  - **Partnering with vendors to support NRC inspection**

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

MOX Lessons Learned
Quality Issues

- Quality of engineering, construction, and vendor components
  - Meet design, safety and regulatory requirements, however, in some cases issues with
    - Document completeness and clarity
    - Technical justification documentation
    - Change control
    - Procedure compliance
    - Document review

MOX Lessons Learned
Quality Issues

- **Document completeness and clarity**
  - **Procedure completeness (written vs skill of craft)**
  - **Clear acceptance criteria**
  - **Clear specification of tolerances**

MOX Lessons Learned
Quality Issues

- **Technical Justification documentation**
  - **Engineering changes, construction nonconformances, vendor nonconformances**
  - **Change technically acceptable**
  - **Justification not clearly documented**

MOX Lessons Learned
Quality Issues

- Change control
  - Incorporating field changes in design documents
- Procedure compliance
  - Storage of records
  - Signatures

MOX Lessons Learned
Quality Issues

- **Document review**
  - **Design input versus design output**
  - **Design output versus vendor documents**
  - **Vendor submittals – compliance with specification requirements**

MOX Lessons Learned

- **Mitigation Strategy**
  - **Classroom training**
  - **Improved procedures**
  - **Use of technical experts**
  - **Improved engineering output documents**
  - **Quality culture initiatives**
  - **Early identification and documentation of issues/questions**

MOX Lessons Learned

- **General observations**

  Construction offers different challenges than engineering development and operating facilities.

  New construction evolutions present new challenges

MOX Lessons Learned

- **General observations**

  Allow appropriate time to layout tools/software/document organization/mechanics of project

  Think through major project philosophies/strategies well in advance (e.g., self procure)

Summary

- MOX Services addressing and mitigating lessons learned
  - Gateway program
  - Training
  - Partnering with vendors and subcontractors
  - Staff in vendor shops
  - Lessons learned
  - Mentoring
  - Quality culture initiatives
  - Industry experts
  - Improved procedures/design outputs

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

Conclusion

- Important to nuclear renaissance to share lessons learned
- MOX project looks forward to future opportunities for industry to continue to share lessons learned