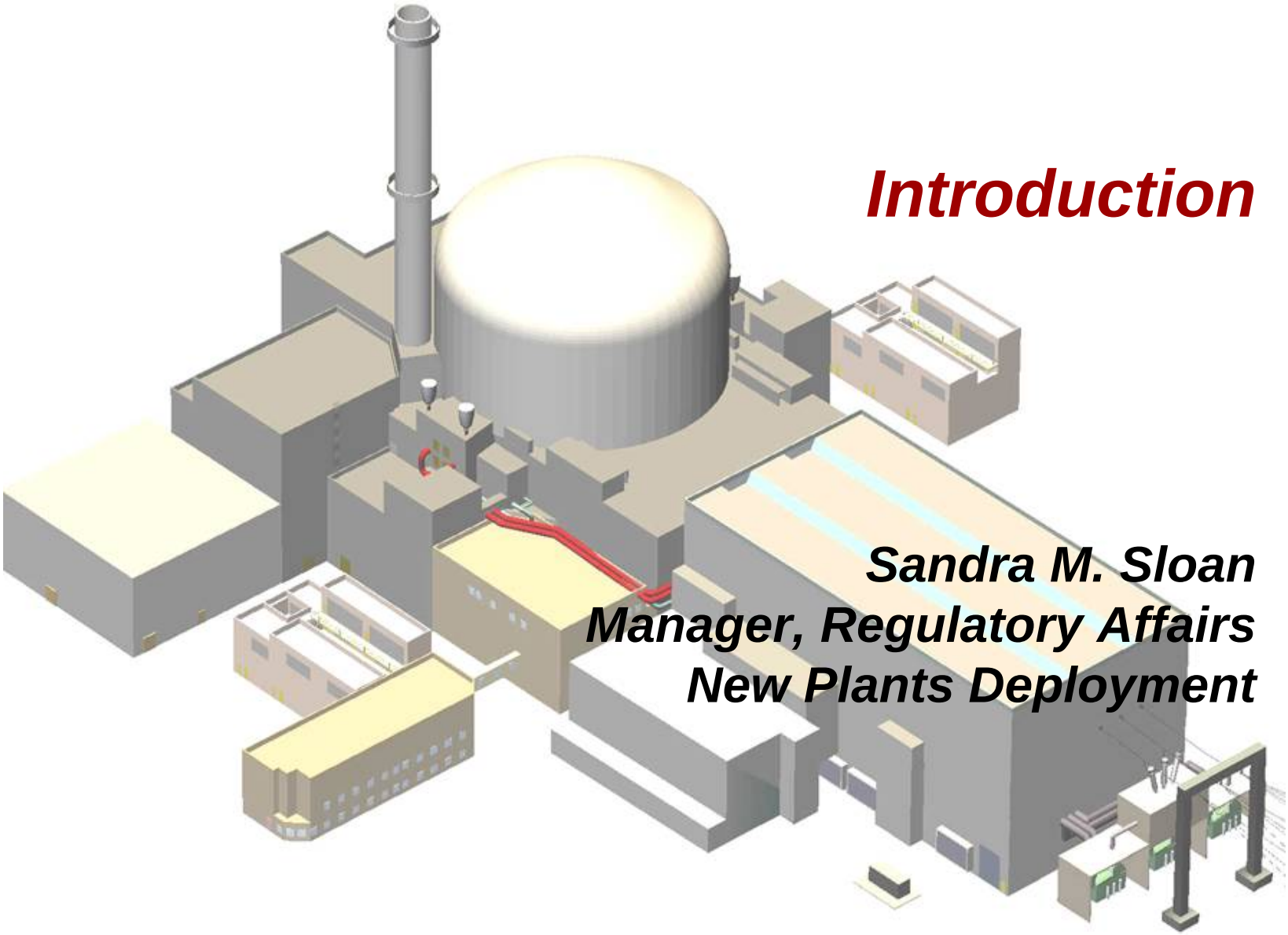
U.S. EPR Pre-Application Review: Human Factors Engineering Program Topical Report

AREVA NP Inc. and the NRC
December 7, 2006

Introduction



Sandra M. Sloan
Manager, Regulatory Affairs
New Plants Deployment

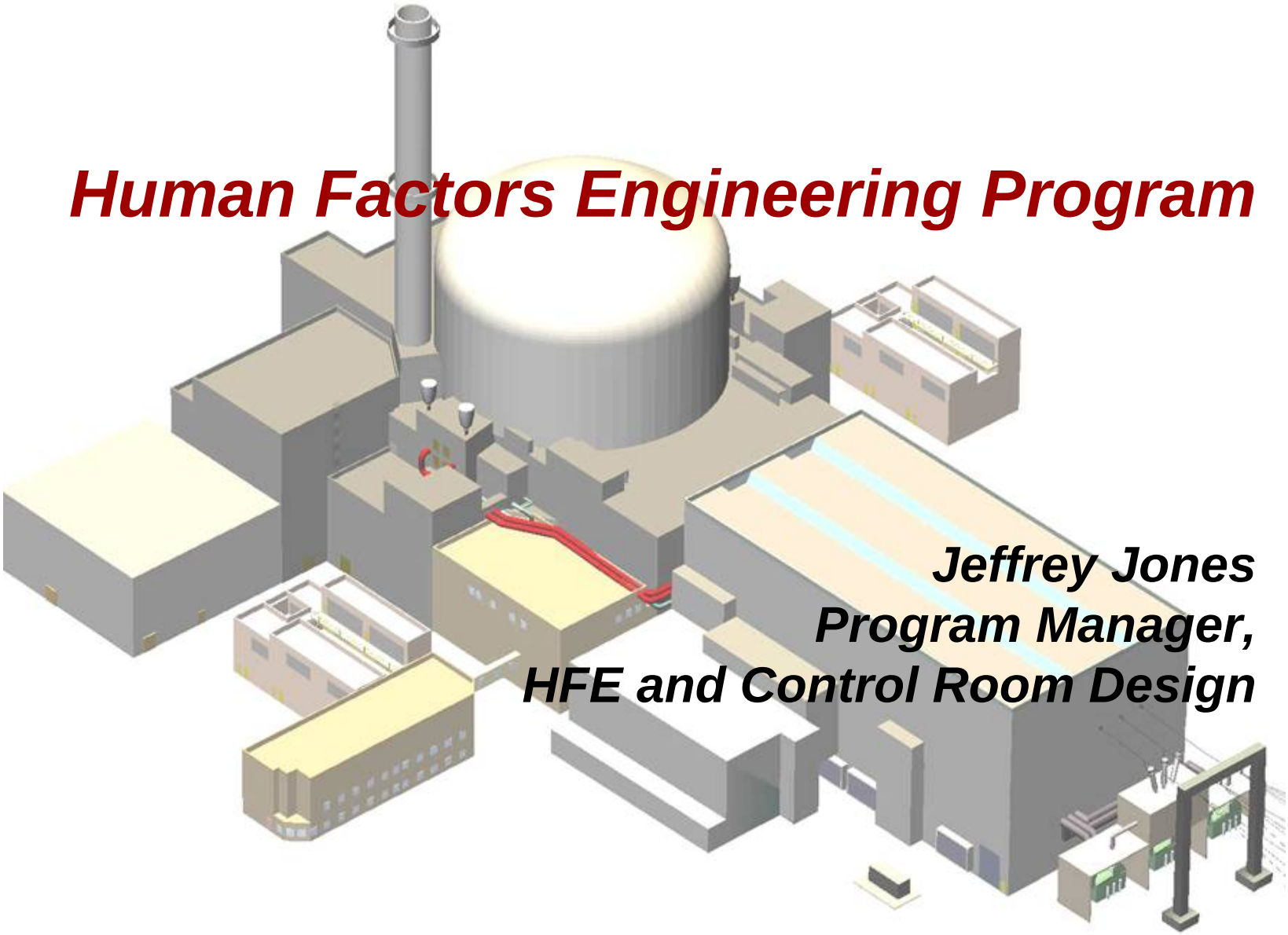
Meeting Objectives

- **Provide an overview of U.S. EPR Human Factors Engineering Program (HFE)**
  - **Preview of HFE Program Topical Report to be submitted in January 2007**
- **As follow-up from the April 2006 and August 2006 meetings on I&C systems**
- **Obtain early NRC feedback on U.S. EPR Human Factors Engineering Program**

Outline

- **Technical Discussions (Jeffrey Jones)**
  - **Scope and Content of U.S. EPR HFE Program Topical Report**
    - **Define HFE Program**
    - **Design Features Inherent to HFE Program**
    - **Design Control Process**
      - **As described in the AREVA NP Quality Assurance Program**
      - **HFE Program deliverables and NUREG-0711 elements integrated into AREVA NPs Design Control Process**
- **Summary and Next Steps (Sandra Sloan)**

Human Factors Engineering Program



Jeffrey Jones
Program Manager,
HFE and Control Room Design

HFE Program Topical Report Format

1. **Program Scope**
   - General Principles
   - Design Goals
2. **Standard Design Features**
   - Control Rooms
   - Human-System Interfaces
3. **Concept of Operations**
   - Staffing
   - Normal / Abnormal Operations
4. **Design Control Process**
   - NUREG-0711 Elements

HFE Scope

- General plant scope
  - Facilities
  - Human-system interfaces
- Specific plant scope and applications
  - Control room details
    - Mechanical properties
    - Acoustic environment
    - Lighting
  - Presentation/Arrangement of information
  - Criteria for automation
  - Alarm system design
  - Operating procedures

Design Features

- **Control Rooms**
  - **Main Control Room (MCR)**
  - **Technical Support Center (TSC)**
  - **Remote Shutdown Station (RSS)**
  - **Instrumentation & Control Service Center (I&CSC)**
- **Human-System Interfaces**
  - **Process Information & Control System (PICS)**
  - **Plant Overview Panel (POP)**
  - **Safety Information & Control System (SICS)**
    - **Qualified Display System (QDS)**

Main Control Room Concept

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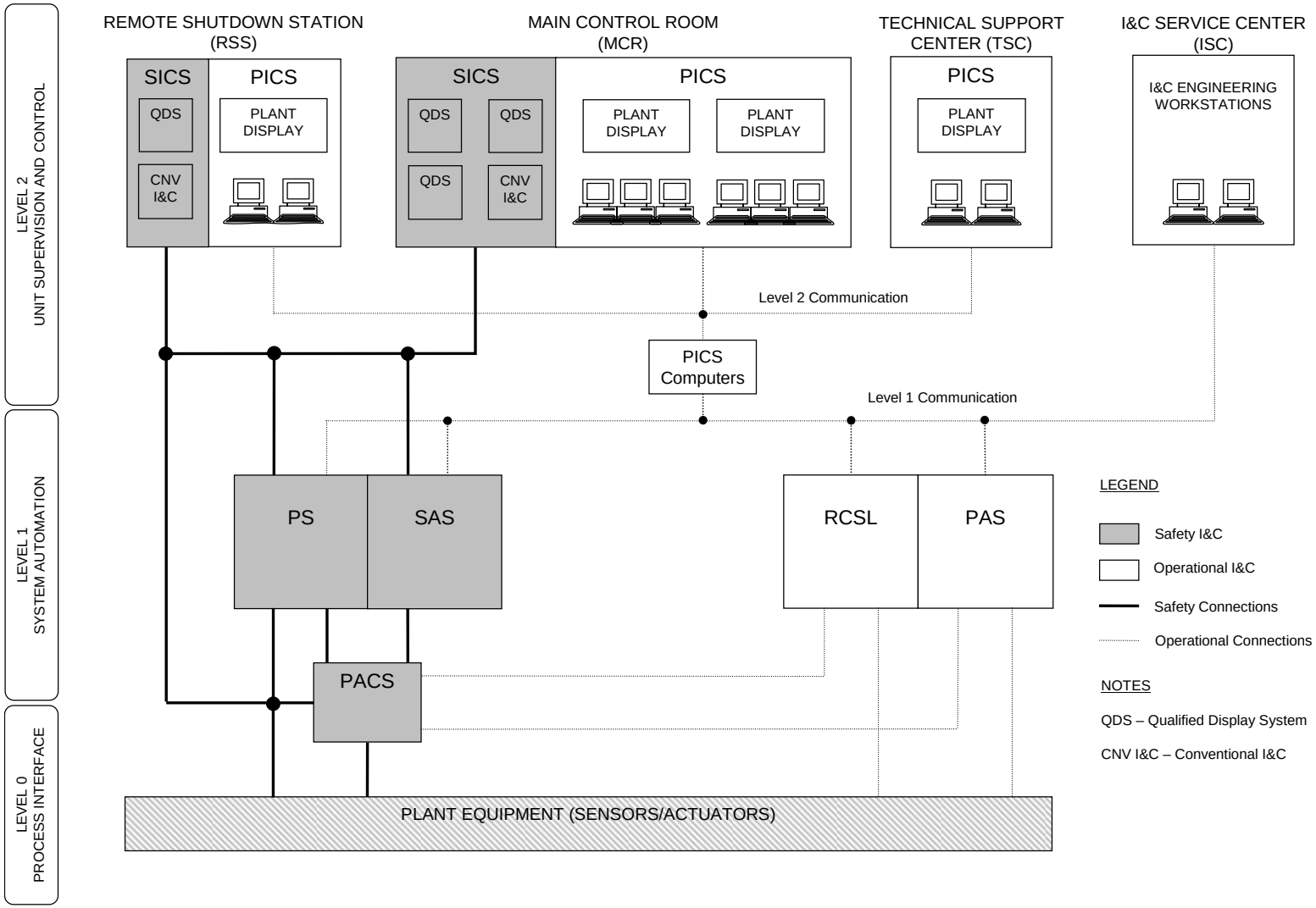
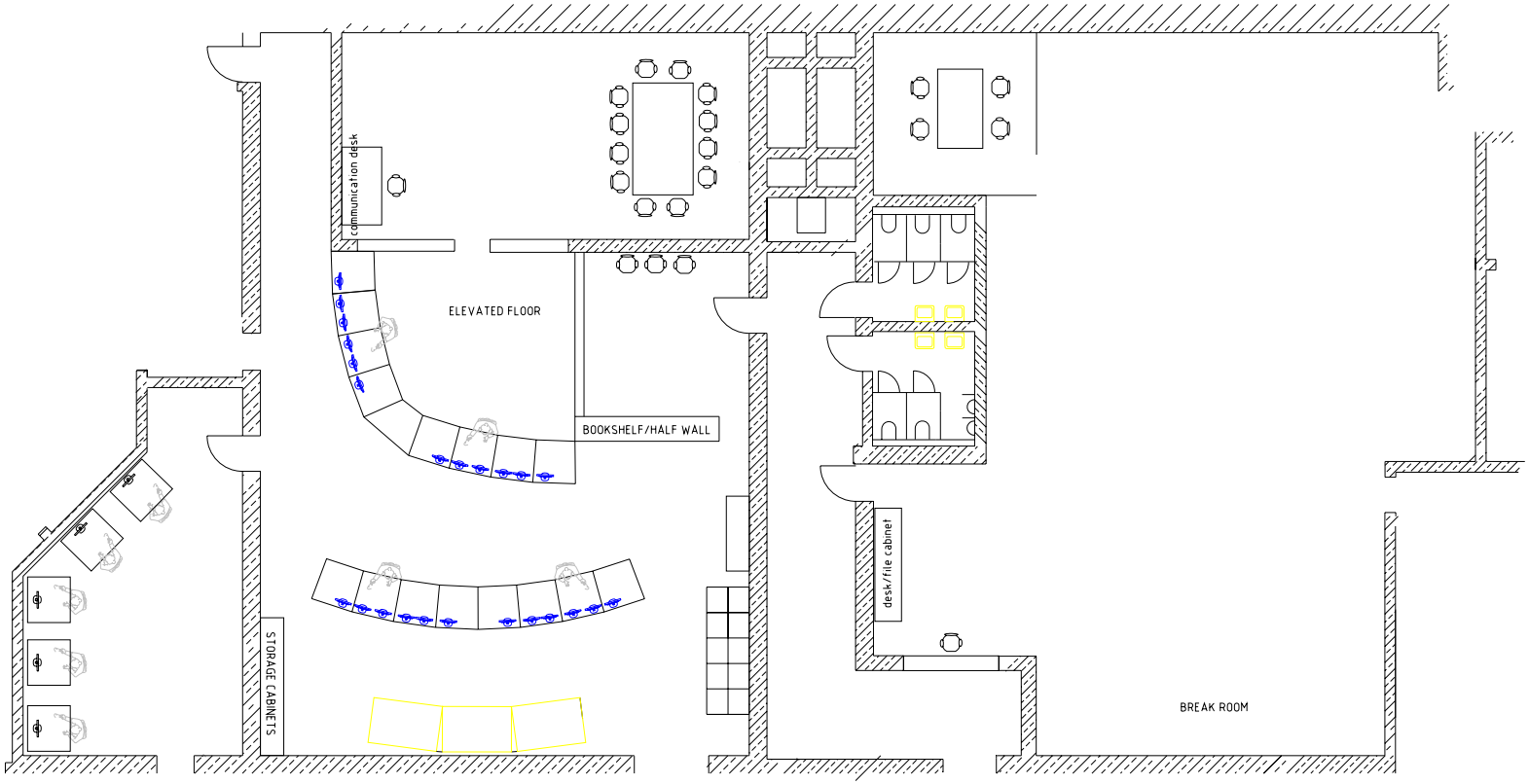
OL3 MCR View (Concept)

U.S. EPR I&C Systems Architecture



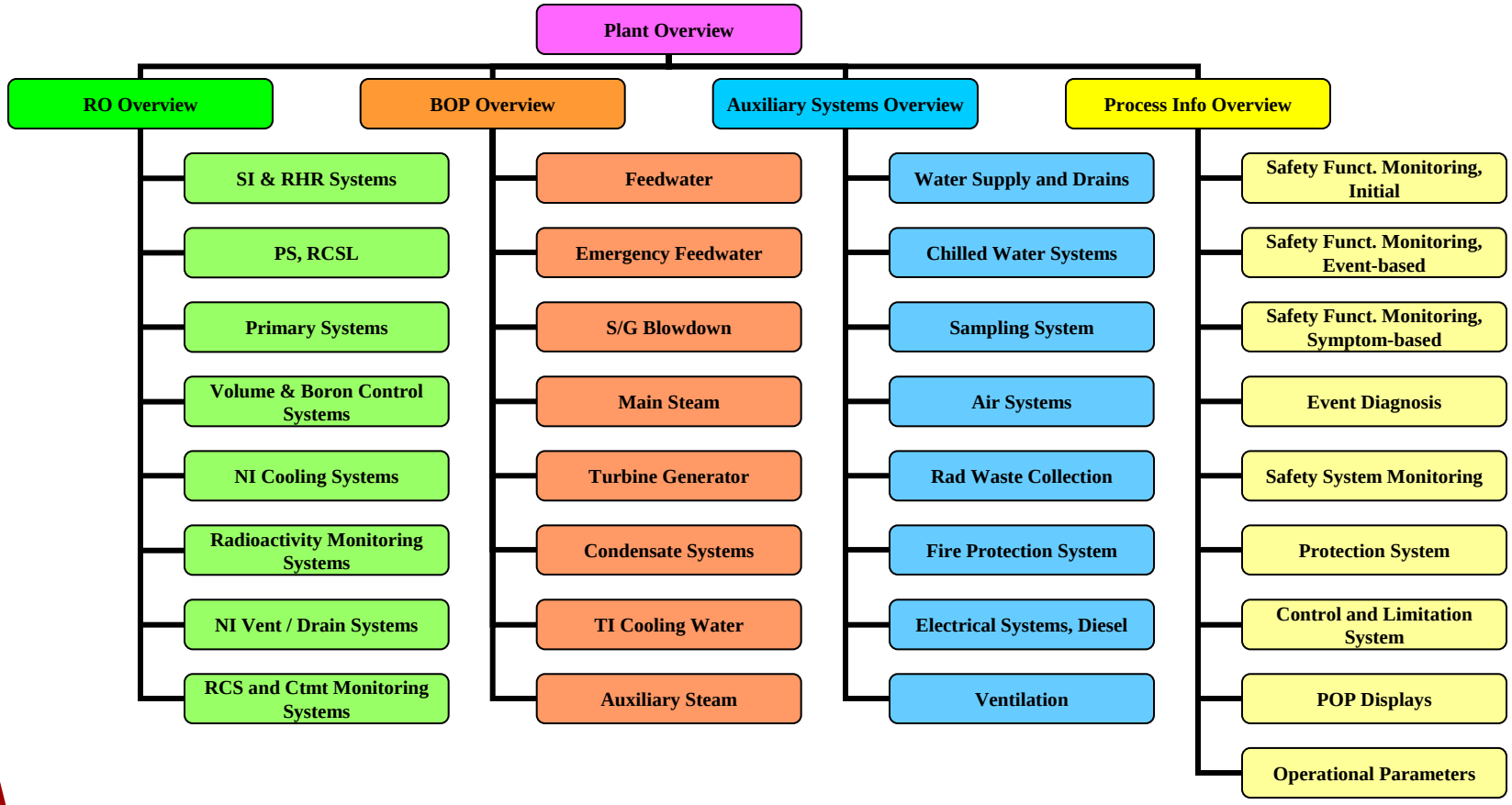
U.S. EPR Control Complex Overview



Concept of Operations

- **Staffing**
  - **Roles of licensed/non-licensed operators**
- **Normal operations**
  - **HSI usage**
  - **Periodic surveillances**
- **Abnormal operations**
  - **Loss of PICS, loss of electronic operating procedures**
- **Loss of MCR**

PICS Display Hierarchy



Design Control Process

- **Design control process**
  - **Translates design inputs to outputs**
  - **Integrates control measures**
  - **Establishes design configuration**
  - **Includes verification methods**
- **HFE program is integrated into design control process**
  - **Also include some implementation plans for individual NUREG-0711 elements**
  - **Majority of HFE output is in System Descriptions**
    - **HSI systems**
      - **PICS, SICS**
    - **Control rooms and major HSI areas**
      - **MCR, TSC, RSS**
  - **NUREG-0711 element output reports**
    - **OER, V&V, Concept of Operations, "Style Guide"**

HFE Program is integrated into the design control process

NUREG-0711 Program Elements

1. Introduction (see DCD)
2. Program Management
   - HFE team organization/composition
   - Responsibilities
   - More details in DCD
3. Operating Experience Review
   - Implementation plan is documented
   - Final report scheduled within “detailed design”

NUREG-0711 Program Elements (continued)

4. Functional Requirements Analysis and Functional Allocation

- Ensures that plant safety functions defined and allocated to human and computerized resources
- Included implicitly in OL3 validated procedures
  - During V&V, AREVA NP will:
    - Examine automation criteria
    - Assess automation implementation
      - Consistency
      - Automation levels do not lead to significant human errors

AREVA NP will validate that OL3 safety significant control functions are correctly and consistently implemented into U.S. EPR design

NUREG-0711 Program Elements (continued)

5. Task Analysis
   - Identifies requirements for accomplishing operator tasks (affects the design of displays, controls, etc.)
   - Included implicitly in OL3 operating procedures
     - Completed operating procedures validate analysis of the tasks the operators must perform to safely operate the plant - the procedures satisfy the required safety objectives
   - For the U.S. EPR, AREVA NP will validate that controls and displays are available and compatible with the intended operations (safety objectives are a subset) as defined in the emergency operating procedures.

NUREG-0711 Program Elements (continued)

6. **Staffing and Qualifications**
   - Initial assumption is documented
   - Final analysis to be documented in System Description Documents for HSIs and in V&V process
7. **Human Reliability Analysis**
   - Risk important human actions identified by PRA considered in:
     - System Design Requirements for design of automation
     - HSI design
     - Procedure and training development
     - V&V scenario development
   - Implementation plan will ensure that risk insights are appropriately incorporated into the HSI design

NUREG-0711 Program Elements (continued)

8. Human-System Interface Design

- Concept of operations is documented
- Major concepts derived from OL3
  - Hierarchy and navigation
  - Alarm management
  - Overall HSI architecture
- OL3 displays will be adapted
  - U.S. symbology
  - Unit specific color coding
  - Function based using ecological design criteria
- Implementation plan is complete
  - Includes a style guide for PICS, SICS, and local control stations
  - Output summary is included in various System Descriptions

NUREG-0711 Program Elements (continued)

9. Procedure Development

- DCD will include description of U.S. EPR program for developing:
  - EOPs
  - Required content of the EOPs (per SRP)
- Operating procedures for U.S. EPR are based on OL3 but reflect plant systems and equipment differences

NUREG-0711 Program Elements (continued)

10. Training Program

- COL applicant responsibility
- AREVA NP supports systematic approach to training (SAT) by providing:
  - Training objectives
  - Knowledge, skills, attributes (KSAs)
- Specific training objectives for U.S. EPR included in DCD

11. Verification and Validation

- Ensures that design conforms to HFE principles (NUREG-0700, Rev.2)
- HF validation includes scenarios based upon PRA/HRA
- Implementation plan completed prior to DCD submittal

NUREG-0711 Program Elements (continued)

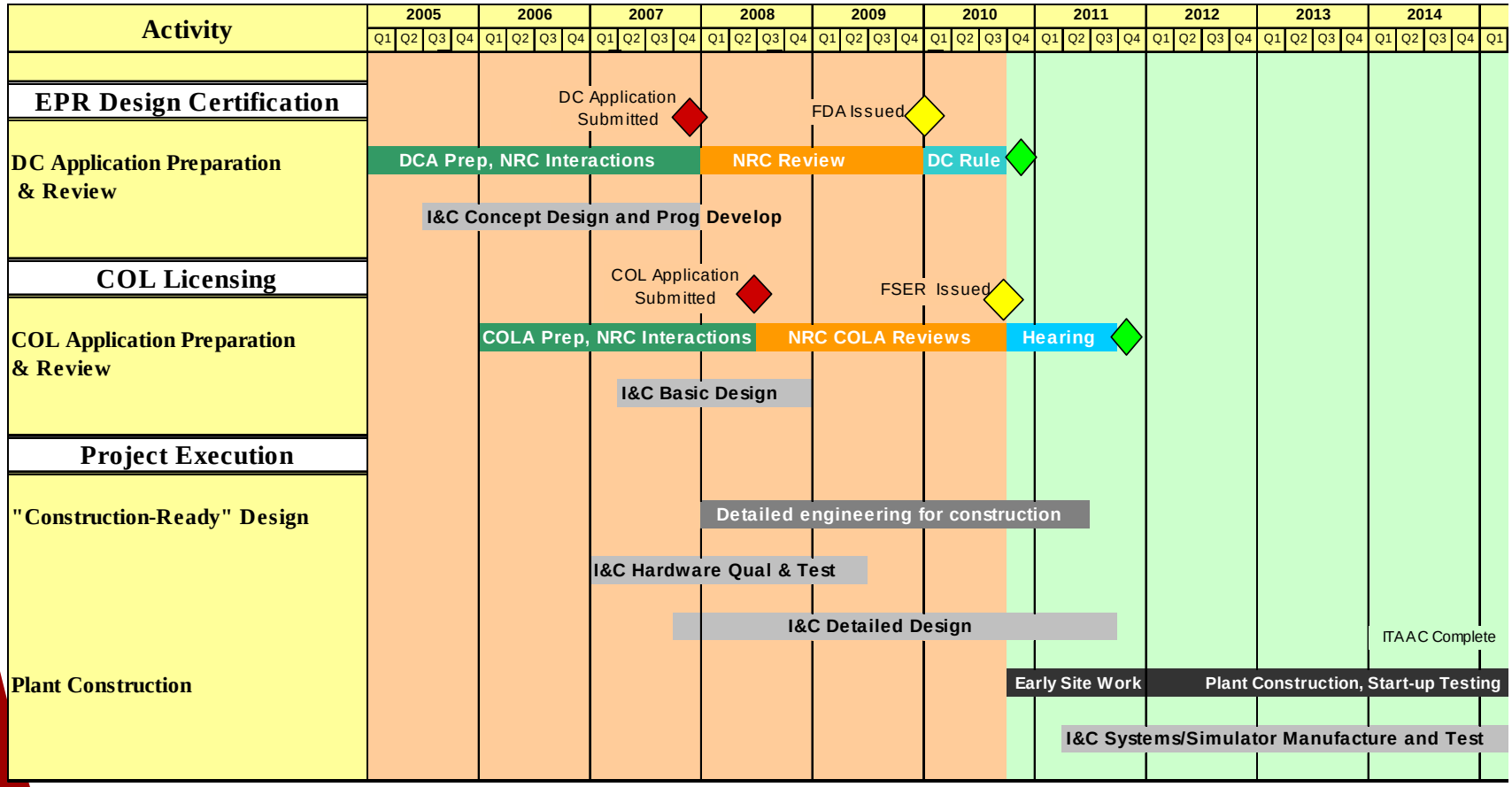
12. Design Implementation

- Resolves any open HFE tracking systems issues
- Implementation plan will be developed in detailed design phase

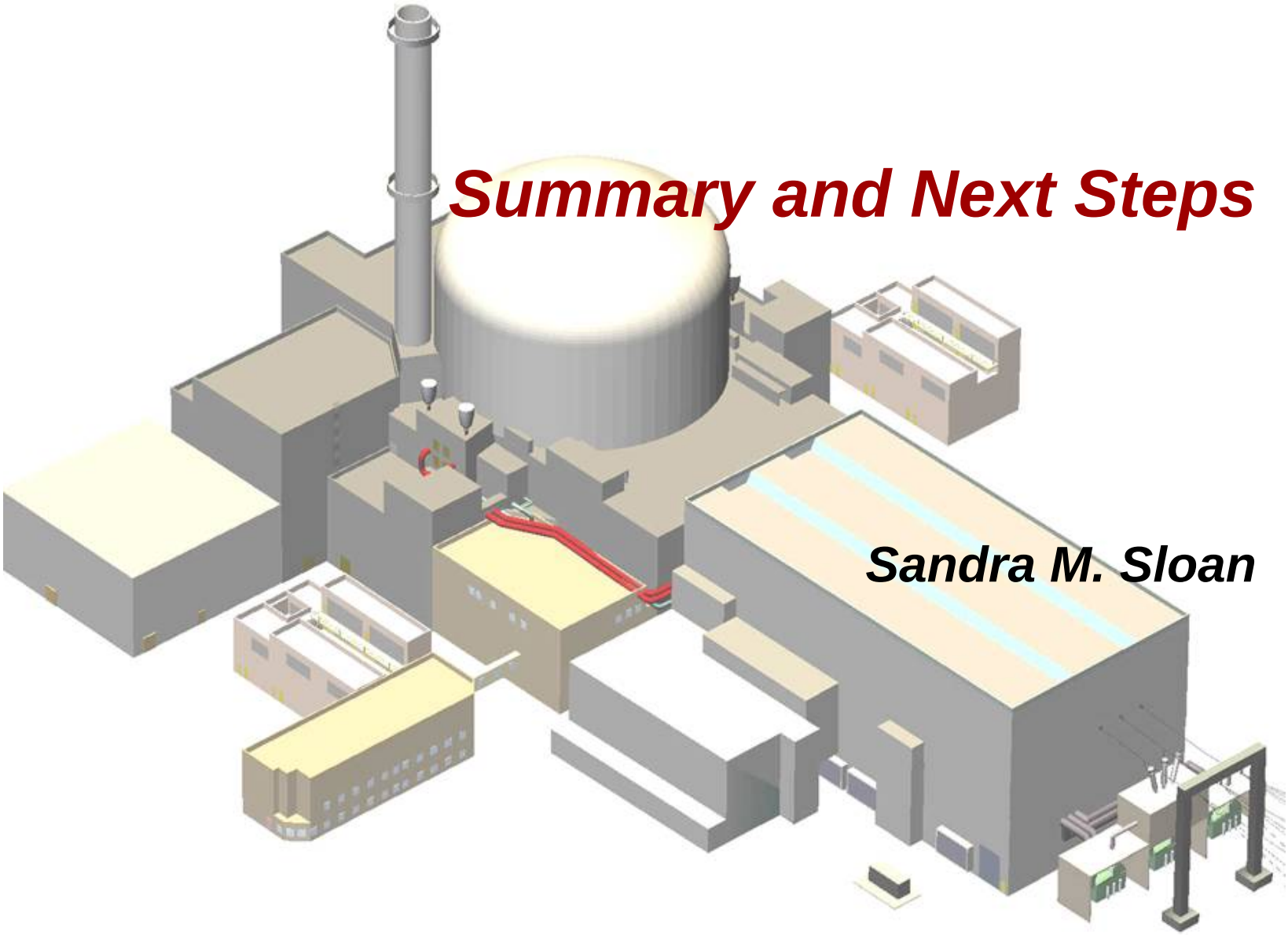
13. Human Performance Monitoring

- Post design configuration control
- HFE is part of Design Change Control process
- HFE integrated in performance and operating experience tracking
- Implementation plan will be developed in detailed design phase

Planned Activities – Timeline



Summary and Next Steps



Sandra M. Sloan

Summary

- **NUREG-0711 elements are addressed in HFE Topical Report**
- **OL3 information is significant, especially for HSI**
- **Within AREVA, I&C design issues are discussed globally**
  - **Global Competence Team**
  - **U.S. representatives in France and Germany**

Next Steps

- **AREVA NP will submit a report that details the principles contained in this presentation (January 2007)**
- **Next meetings:**
  - **January 24, 2007: Instrument Setpoint Methodology pre-submittal meeting**
  - **AREVA NP proposes April 2007 HFE program post-submittal meeting**

Acronyms

CNV I&C:	Conventional I&C
DCD:	Design Control Document
EOPs:	Emergency Operating Procedures
HFE:	Human Factors Engineering
HSI:	Human-System Interface
I&C:	Instrumentation and Controls
I&CSC:	I&C Service Center
MCR:	Main Control Room
OER:	Operating Experience Review
OL3:	Olkiluoto 3 (Finnish Nuclear Plant)
PICS:	Process Information and Control System
POP:	Plant Overview Panel
QDS:	Qualified Display System
RSS:	Remote Shutdown Station
SAT:	Systematic Approach to Training
SICS:	Safety Information and Control System
TSC:	Technical Support Center
V&V:	Verification and Validation