# Phase 0 Meeting: Idaho State University AGN-201M

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Thursday, August 16, 2018 at 08:00 MDT

# Topics

- Goals of Meeting
- ISU's Project Approach
- Design Basis of AGN-201 Reactor
- Reasons for Choosing Analog
- ISU Methodology for Console Replacement
- Requirements, Codes and Standards
- Licensing Approach
- Status of Project and Remaining Activities
- Personnel
- Questions & Feedback

# Goals of Meeting

- Communication of ISU's Project Approach
  - Involvement of experienced industry personnel
  - Steps including review and testing to ensure design and installation meets requirements and will operate as expected
- Communication of ISU's Licensing Approach
- Request Feedback from NRC
- Outline Steps to Project Completion

# ISU's Project Approach

- Goal of Project: Produce a working, tested and documented design that meets the requirements of Safety Analysis and needs of the University to support the AGN-201 teaching/training reactor
- Involve experienced industry and community engineers who mentor, help, and review the design and project
- Conduct and document reviews of Design Basis and other requirements
- Document assembly and testing
- Document stepwise Increasingly complex testing:

Bench-Testing → Integrated Operation with Reactor subcritical → Integrated Operation with Reactor critical

# Design Basis of AGN-201 Reactor

- Evaluated in original Hazards Analysis from 1956, confirmed in updated FSAR (2003) and Informal Evaluation (2018) of maximum credible accident based on current configuration and measured operational parameters
- Inherently safe nuclear design
  - Small amount of fuel (672 grams $U^{235}$)
  - Very significant negative Moderator Temperature Coefficient (MTC) of polyethylene fuel matrix
  - 'Safety fuse link' (polystyrene) terminates any possible unplanned power excursion
  - Polyethylene core contains fission products
  - This results in
    - Essentially no chance of radiation release to public
    - No need for a reactor protection system

# Design Basis of Reactor (Continued)

- Consequently
  - No safety-related trips are required to prevent release of fission products
  - Components can be commercial grade quality
  - The functionality of the original instrumentation will be replicated in the replacement system
  - No changes to Technical Specifications

# Analog Replacement System

- Solid-state modern components replace original tubes and components
- Same functions, including trips
- Minor change in rod magnet release configuration (parallel rather than series, while retaining the series scram)
- Tested and validated in stepwise approach of increasing integrated operation


## Current Analog Control Console

Still in use the ISU AGN-201 today


## New Analog Control Console

The general concept and layout of the new AGN-201 control console

# Reasons for Maintaining Analog

- Solid-State analog easily replaces existing tube-based system in function, form, and approach.
- Stand-alone, no dependence on outside for updates
- No software bugs to discover and remedy
- Secure – Impossible to hack
- Greatly reduced hardware and software obsolescence
- Relatively straightforward to build and understand
- Failure Modes – simple and easy to identify, understand and remedy
- Regulatory acceptance anticipated to be easier

# Requirements, Codes and Standards, Generic Letter 96-01, NUREG-1537

- No IEEE (or similar) standards referenced in ISU's SAR
- Good engineering practice to evaluate against two major codes: IEEE-603 and IEEE-279
- Generic Letter 96-01 used as guidance for testing procedures

# Licensing Conclusion and Approach

- No changes to transients or requirements in SAR
  - Updates to the SAR for the controls upgrade after the installation
- No changes in analog design approach other than rod release magnet wiring configuration and rod position indication
- No changes to the Technical Specifications
- ISU is proceeding to complete the 50.59 Screen and Evaluation
  - ISU has recently written a procedure to provide better guidance for 50.59 Evaluations; and
  - ISU is confident that a 50.59 Screen and Evaluation for this modification will allow this to be performed under 50.59

# Status of Project

- In April, 2018
  - Consultants Bondurant and Phoenix joined project
  - Replacement is now conducted as a Project with meetings, agendas, action items, minutes
- Instrumentation Design is complete and tested for proper operation. Design is documented via Maxwell Daniels
- Design of Internals of Cabinet is nearly complete and is being wired and tested. Design is documented via Ashoak Nagarajan

# Remaining Activities

- Write and verify operating, maintenance and surveillance procedures
- Complete cabinet wiring and testing
- Replace and test Control rod position indicators
- Write, review, and approve 50.59
- Replace old control system with new control system
- Conduct phased, integrated testing
- Report written by Phoenix of the design, testing, licensing and documentation with a review by Bondurant.
- ISU's Reactor Safety Committee review
- Project completion

# Idaho State University Personnel

- Jay Kunze (PhD, PE, CHP) – 60 years nuclear experience, first as a critical experiment operator, and then 12 years as director of two critical facilities at the INL(then NRTS), 5 years as oversight manager of ATRC, ETRC, ARMF at INL, 11 years Nuclear Safety Review Board for Callaway, 8 years as chair of MURR Reactor Safety Comm.,12 years as reactor administrator for ISU AGN-201, currently on Reactor Safety Committee
- Mr. Maxwell Daniels – 2 years experience as the Reactor Supervisor and 4 years experience as an SRO on the current control console. Intimately familiar with the AGN-201 reactor facility and associated systems.
- Mr. Ashoak Nagarajan – 2 years of experience with the AGN-201 reactor, including a master's degree in Measurements and Controls Engineering for a reactor system

# Design Consultants and Mentors

- Mr. James Larson – Decades of Consulting Experience in Analog Design & Construction, Operation. Principal control system engineer at ANL-EBRII for 30 years. Mentored Mr. Daniels and Mr. Nagarajan on their thesis.
- Mr. Craig Shull – Analog Design, Drafting and Construction/Integration of control systems. Over 20 years working on analog control systems. Mentored Mr. Nagarajan on his thesis.

# Recent Consultants from Commercial Industry now Working at Idaho National Laboratory

- Not affiliated with the INL for this project
- Joined project after instrument design was completed and construction well underway
- Bill Phoenix
  - Review of design and project manager
  - 3 PE licenses: Controls, Mechanical, Nuclear
  - Started up Calvert Cliffs 1, St. Lucie 1, LOFT, SONGS 2 and 3, Vogtle 1 and 2 and Sizewell 'B'
  - I&C Consultant to the restart and I&C and reactor physics continuing operation of the TREAT reactor at Idaho National Laboratory

# Project Personnel

- Stuart Bondurant
  - Review of design, consultant on licensing approach
  - Over 30 years experience with commercial nuclear plant I&C Systems
  - Experience with Oconee Reactor protection system/ engineered safety features system replacement
  - Experience with AREVA EPR I&C Systems
  - Experience with Bellefonte completion of I&C Systems
  - I&C consultant to the restart and continuing operation of the TREAT reactor at INL

# Questions and Feedback

- Do you have any comments to provide on our licensing approach going forwards?
- Any questions?