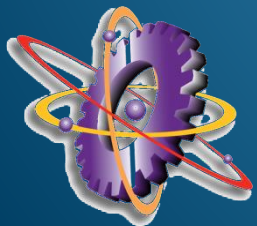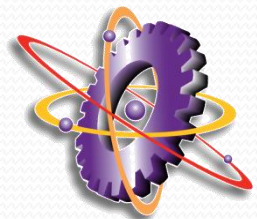# KSU Reactor Console Replacement Status Report

Jeffrey A. Geuther, Pennsylvania State University

Amir Bahadori and Max E. Nager, Kansas State University

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Introduction

- The KSU reactor operates with a console procured from USGS in 1992.

- The console itself is 50 years old.

- A 2015 NEUP reactor infrastructure grant has provided $1.495 M for upgrading the console and NIs.
  - DE-NE-0008372
  - Period of performance: 9/10/15 – 9/9/18

- The upgrade will be completed in January 2018.

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Operations at KSU

- The KSU reactor supports:
  - 2 weekly / bi-weekly lab classes
  - Tours and projects for ~12 classes / semester
  - ~2000 visitors per year
  - Various research and service projects
- Minimal professional staffing, supported by 6-10 student reactor operators and reactor operators.
  - Need to avoid creating unnecessary licensing or engineering challenges.
 - Sticking with analog safety channels + controls
 - 10CFR50.59
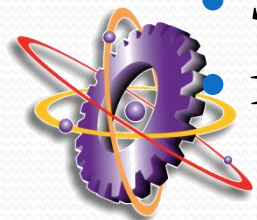
Original Console (1962 – 1992)
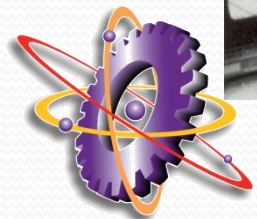
Need For New Console

- Existing console was procured from USGS in early 1990s
  - Original build date of 1967
  - Long lifetime, but recently frequent upgrades and repairs have been needed to maintain usability
    - Linear and Percent Power channels
    - CDM power supplies
 - Maintenance outages and difficulty in procuring parts has become a more frequent problem

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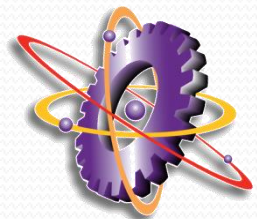
Existing Console
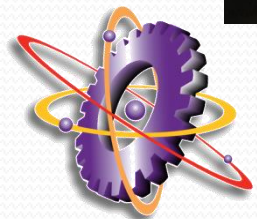
New Console Specifications

- Avoid license amendment
  - Updated digital instrumentation
  - No digital control or safety channels
- Additional capabilities
  - Pulse fire relay output
  - Rod drop timer
  - Pulse tracing
  - Additional NI channel for redundancy
  - Touchscreen PC added to console for general use.
  - Radiation monitoring channels included in console instrumentation.
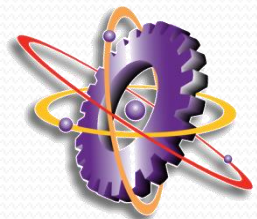- Two vendors submitted bids; Thermo was selected.
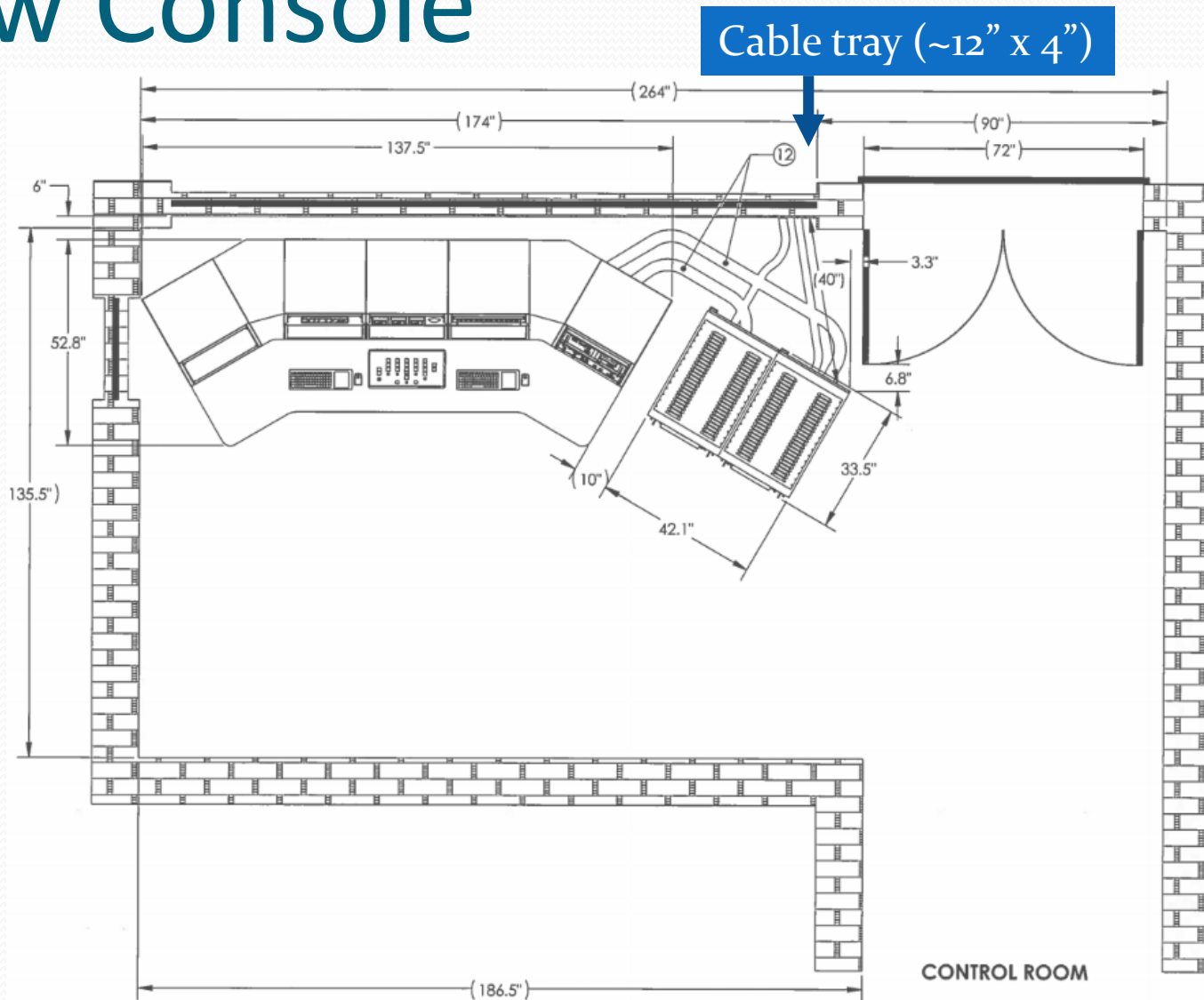
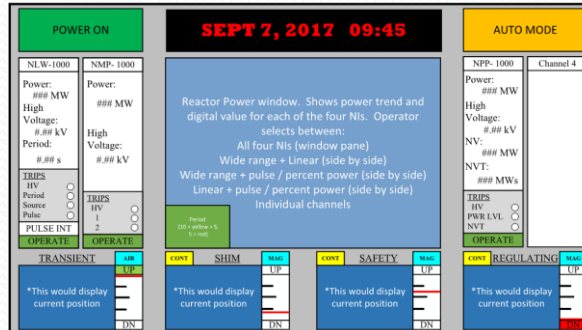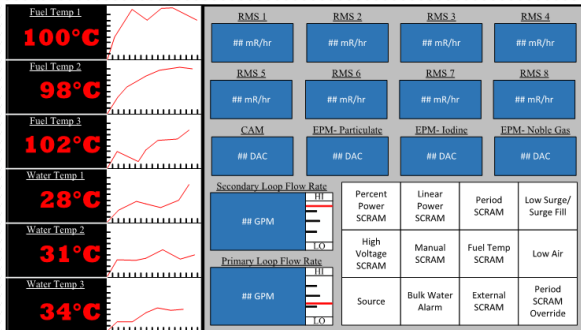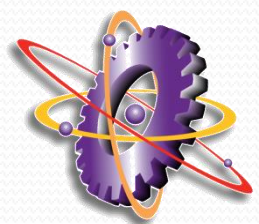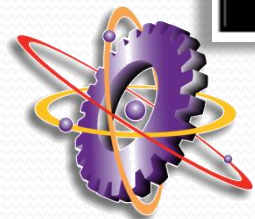KANSAS STATE UNIVERSITY | TRIGA Mk II Nuclear Reactor Laboratory
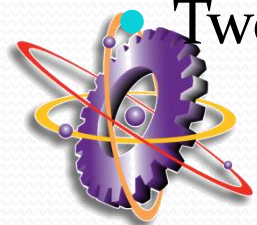
Added Improvements
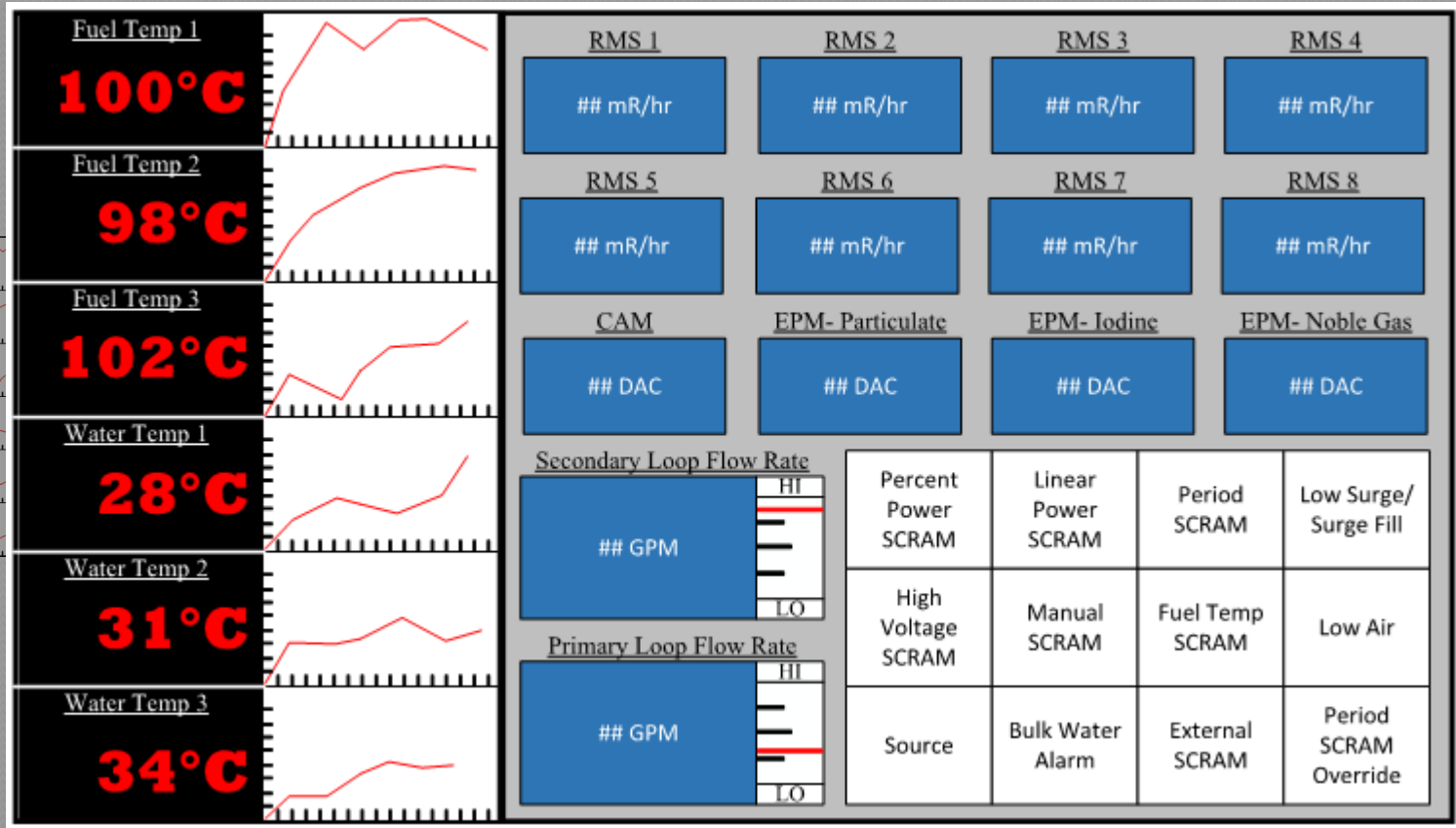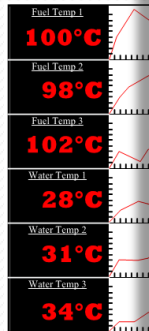
- Reduced source range noise / wider-range response
- Customizable panel layout
- New CDM power supplies and cables
- Replace nuclear instruments
- Reduce clutter in cable tray
- Audio scaler on SU channel
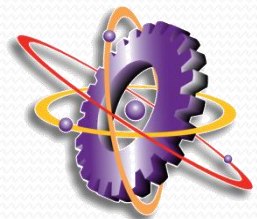
NI Channels

GA NLW-1000 + FC	2 Thermo TR-10-5 +FC
GA NMP-1000 + CIC	Thermo TR-30 + CIC
GA NPP-1000 + UIC	Thermo Pulse Power + GIC
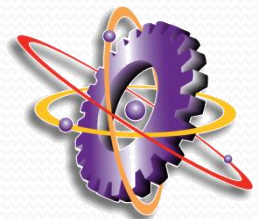
New Console

Blank panel for phone, intercoms, and PC

3 Foxboro screens

CDM controls
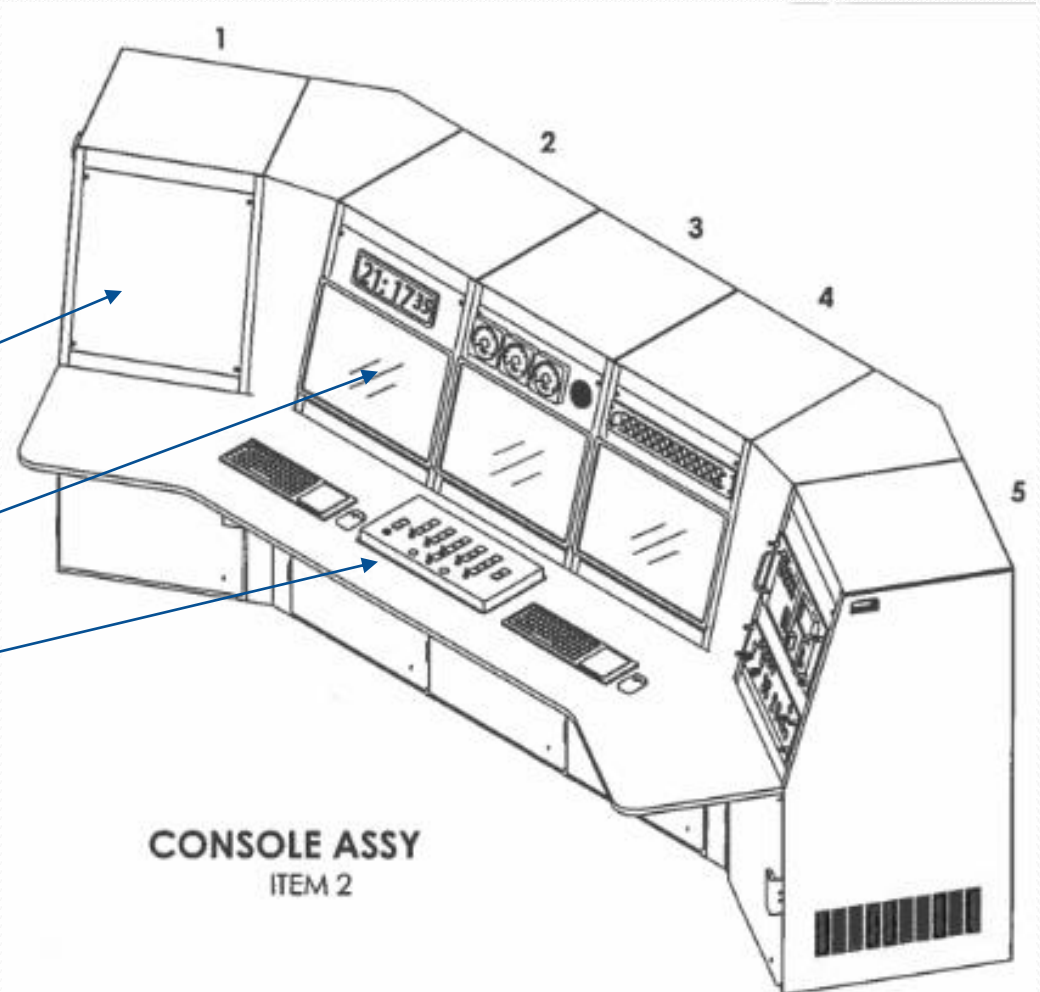
CONSOLE ASSY
ITEM 2
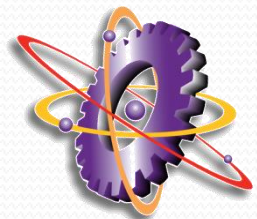
New Console

SV180 recorders

Audio scaler

NI drawers
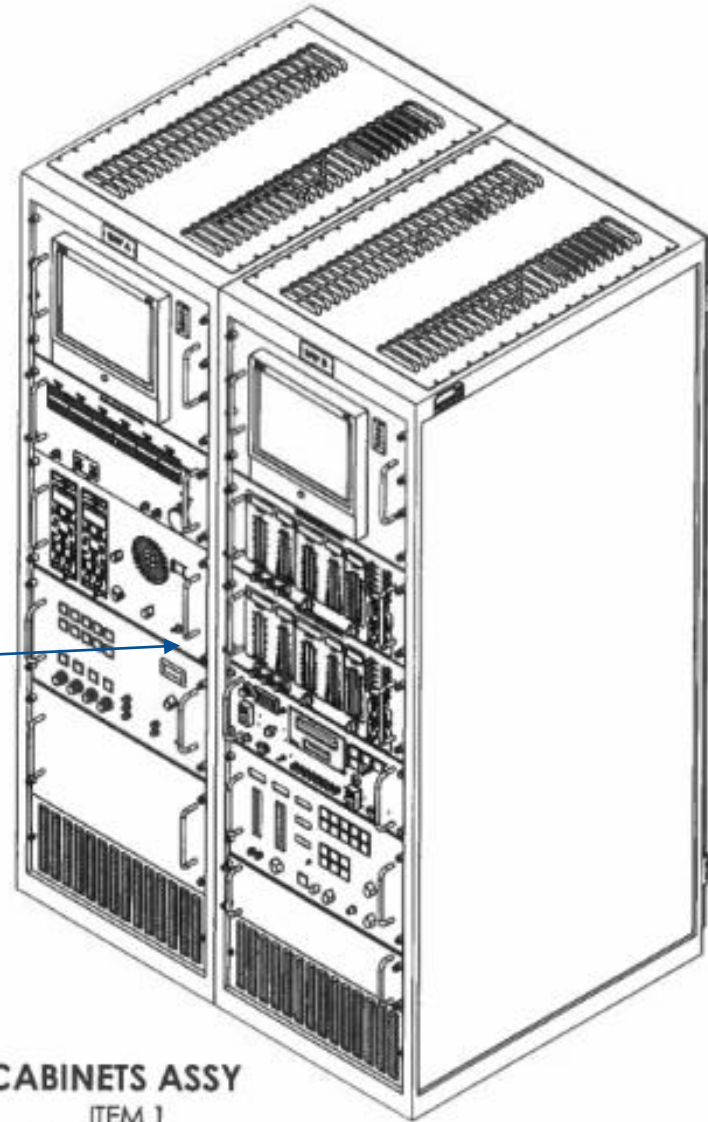
CABINETS ASSY
ITEM 1
SHEETS 3 & 4

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New Console

Cable tray (~12" x 4")
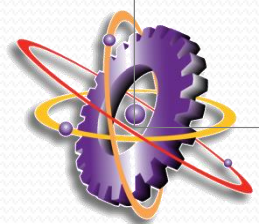
CONTROL ROOM
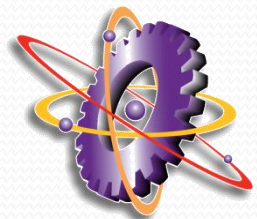
Digital Interface

(In progress)

Digital Interface

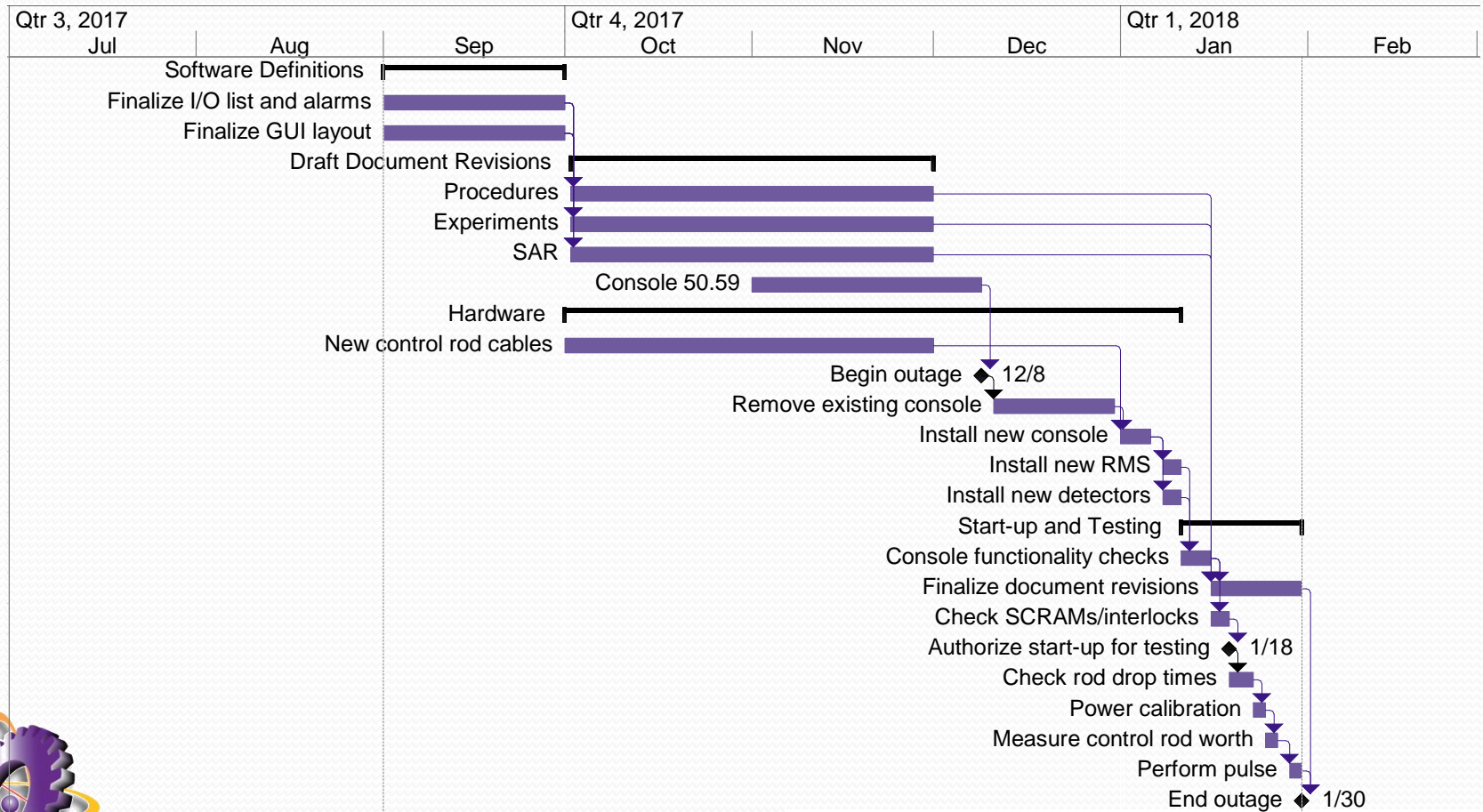# Digital Interface

Project Schedule

	Qtr 3, 2017			Qtr 4, 2017			Qtr 1, 2018	
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb

Software Definitions

Finalize I/O list and alarms

Finalize GUI layout

Draft Document Revisions

Procedures

Experiments

SAR

Console 50.59

Hardware

New control rod cables

Begin outage ◆ 12/8

Remove existing console

Install new console

Install new RMS

Install new detectors

Start-up and Testing

Console functionality checks

Finalize document revisions

Check SCRAMs/interlocks

Authorize start-up for testing ◆ 1/18

Check rod drop times

Power calibration

Measure control rod worth

Perform pulse

End outage ◆ 1/30

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Challenges

- Staffing
  - Interim Reactor Manager and Reactor Supervisor
    - Previous Manager / Supervisor attends weekly teleconferences
  - Staff availability to complete project
- Documentation challenges
  - Ensuring all documents are updated appropriately
  - No experience with new console
  - Reactor Safeguards Committee coordination
- Pulse tracing integration into Foxboro panels
- Current console maintenance
- Concurrent LAR for 12% fuel
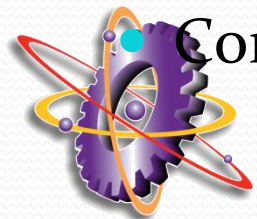
Status

- Console hardware definition nearly complete
- Input/output list and alarms defined in draft form
- GUI layout started
- Documentation requiring revision identified
- Console 50.59 in progress
- Contacted vendor for new control rod cables

Plans for Startup and Testing

- Rewrite Procedures:
  - Startup, calibrations, pulsing, etc.
  - RSC approval
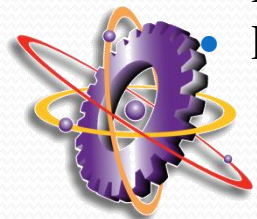- V & V prior to startup:
  - Interlock/scram tests
  - CR drop timing
  - Temperature channel calibration
  - Pulse channel calibration
  - Finalize 50.59
- V & V after startup:
  - Vendor-recommended startup testing (Thermo present)
  - Core reactivity measurements
  - Power calibration
  - Re-calibrate control rods
  - Perform pulse

Other Notes

- KSU has a lot of GA console components from the same vintage as the USGS console
  - Many given by NRAD after their console upgrade.
  - Most are cataloged and would be easy to find.

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