DWIGHT LOOK COLLEGE OF ENGINEERING

Department of Nuclear Engineering

TEXAS A&M UNIVERSITY

July 11, 2011

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Docket No. 50-059

SUBJECT: Supplemental Information for the Texas A&M University AGN-201M reactor License Application

To supplement the license application for the Texas A&M University AGN-201M reactor, modification authorization 2008-1 dated January 23, 2008 is being submitted. This document outlines the reactor console instrumentation and electronics upgrade performed by the facility. Also included is the Statement of Intent for decommissioning costs.

If you have any questions, please do not hesitate to contact me at: (979) 845-4161, or e-mail at rjuzaitis@tamu.edu.

I declare under penalty of perjury that the foregoing is true and correct. Executed on July 11, 2011.

Sincerely,

Raymond J. Juzaitis, Ph.D.
Department Head

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DWIGHT LOOK COLLEGE OF ENGINEERING

Department of Nuclear Engineering

TEXAS A&M UNIVERSITY

June 16, 2011

U. S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: TAMU AGN-201M Teaching Reactor, (TAC. NO. ME1588)
Texas A&M University
Financial Assurance

STATEMENT OF INTENT

As Department Head of the Nuclear Engineering Department at Texas A&M University, I exercise authority and responsibility to request from the Dean of the College of Engineering funds for decommissioning activities associated with operations authorized by the U. S. Nuclear Regulatory Commission TAMU AGN-201M (TAC NO. ME1588). This authority is established by the President's Delegation of Authority for Contract Administration (see attached, Section 9.1 Permits, Licenses, Declaration, Applications Filed with Regulatory Agencies). Within this authority, I intend to request that funds be made available in the amount of $ 97,850 to decommission the AGN Reactor located in the Zachry Building (Bldg. 518) on the campus of Texas A&M University, College Station, Texas 77845 (estimated costs of decommissioning are $97,850). I intend to request and obtain these funds sufficiently in advance of decommissioning to prevent delay of required activities.

Raymond J. Juzaitis, Ph.D.
Department Head
Sallie & Don Davis '61 Professor of Engineering
Department of Nuclear Engineering

G. Kemble Bennett, Ph.D., P.E.
Vice Chancellor and Dean of Engineering
Director, Texas Engineering Experiment Station
Harold J. Haynes Dean's Chair Professor

Phillip Ray
Associate Vice President for Finance
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Texas A&M University
Department of Nuclear Engineering

MODIFICATION AUTHORIZATION

Title: AGN Reactor Console Instrumentation and Electronics Upgrade

1. **AGN Staff Review:** [signature] Department Head 1/22/08 Date

2. **Reactor Safety Board Review:**

The Reactor Safety Board has reviewed the hazards associated with this modification IAW 10 CFR 50.59 and has determined that it does not:

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the final safety analysis report (as updated);
2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety previously evaluated in the final safety analysis report (as updated);
3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the final safety analysis report (as updated);
4. Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the final safety analysis report (as updated);
5. Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report (as updated);
6. Create a possibility for a malfunction of an SSC important to safety with a different result than any previously evaluated in the final safety analysis report (as updated);
7. Result in a design basis limit for a fission product barrier as described in the FSAR (as updated) being exceeded or altered; or
8. Result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses.

Approval Confirmed: Theresa A Maldonado RSB Chairman 1/23/08 Date

3. **Restrictions:**

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4. **RSB Subcommittee Review (if necessary):**

Name (Print): ____________ Signature: ____________ Date: ________

Name (Print): ____________ Signature: ____________ Date: ________

5. **Final Modification Authorization:**

Head (Print): ____________ Signature: ____________ Date: ________

Safety Evaluation of the AGN Reactor Console Instrumentation and Electronics Upgrade

Introduction

The Texas A&M University AGN console instrumentation and electronics has been used since 1957. The analog console was very old and replacement parts were no longer available. The upgraded digital console will enhance the human-machine interface. The console enables the operator or students to view digital displays, store data, and retrieve this data in digital form. Considering the educational function of AGN reactor, digital data acquisition during operation or experiments is highly desirable. Since commercial nuclear plants, existing and forthcoming, have adopted advanced features such as digital I&C, we feel training reactors must also adopt these to avoid obsolescence.

This review is not theoretical but based on tests of the as-built console.

Description

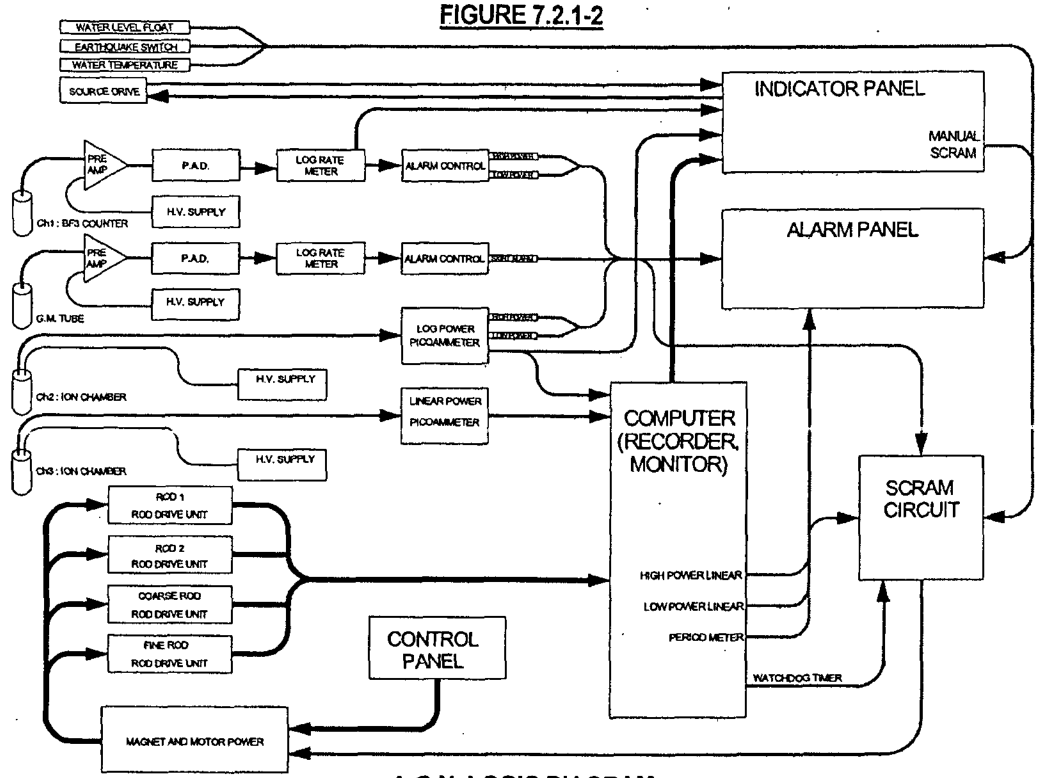
In accordance with Reg. Guide 1.70, 7.5.1 Safety-Related Display Instrumentation, the SAR should "include a description of the instrumentation systems (including control rod position indicating systems) that provides information to enable the operator to perform required safety functions."

The upgraded console is designed to have the same or better function compared to the original console. The instrumentations used have high functional reliability in harsh environments. Interlock and scram logics are same as described in FSAR Figure 7.2.1-1 and 7.2.1-2. The upgraded equipment in the console is as follows. The detailed equipment specifications are listed in Appendix A.

- P.A.D.(Preamp/Amp/Disc)
- Log ratemeter
- GM Detector
- Encoder
- Picoammeter
- Alarm control
- Power supply
- Nim Bin

As shown in the following figure, the logic is the same as in the old console except a computer used as digital recorder and monitor. The scram circuit is designed to trip the reactor immediately when the computer fails. The signals from some channels will bypass the computer and actuate the scram directly so that the safety redundancy is maintained.

FIGURE 7.2.1-2



A.G.N. LOGIC DIAGRAM

Safety Evaluation

In accordance with 10 CFR 50 Appendix A. General Design Criteria 13, *Instrumentation and control*, "Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions." The following analysis and evaluation adequately demonstrate that the updated console instrumentation provides the same functions as described in FSAR and the same information necessary for the operator to perform required safety functions.

The scram circuitry and electronic controls are the same as used at the Nuclear Science Center where we have decades of operating experience. The function and operability of scram and interlocks will be confirmed through the daily channel testing and calibration. The new instruments are an update and improvement over the replaced instruments. These instruments are more reliable and sufficient means are available to indicate problems with the instruments so that this modification will not present a safety issue.

While certainly the components of the electronics themselves have changed, we have preserved the console functionality as described in the Technical Specifications. The relevant Technical Specifications that pertain to these console modifications are:

T/S 2.1.a. The reactor power level shall not exceed 100 watts.

Discussion: Neither the detectors nor their position relative to the core have changed. We replaced the counting train for Channel #1 and Channel #2 with off-the-shelf NIMbin modules. During initial critical testing we will calibrate the detectors against flux foil measurements (at a fraction of full power) to establish the power levels and LSSS for the reactor.

T/S 2.2.a. The safety channels shall initiate a reactor scram at the following limiting safety system settings:

Channel	Condition	LSSS
Nuclear Safety #2	High Power	<10 Watts
Nuclear Safety #3	High Power	<10 Watts

Discussion: The detectors for Channel #2 and Channel #3 and their positions relative to the reactor are unchanged. The counting trains are off-the-shelf NIMbin modules and will be calibrated against flux foil measurements at low power.

T/S 3.2.b The average reactivity addition rate for each control or safety rod shall not exceed 0.065% $\Delta k/k$ per second.

Discussion: Based on current rod worth data, this worth limits the control rods movement to 17.8 seconds or greater times for full insertion. We have lowered the operating voltage to the drive motors and the insertion times for all rods have increased from 22 to 29 seconds to 31 to 38 seconds, becoming more conservative. The out-of-core measurements for rod movement are:

Rod	Previous insertion time	After console modification
Safety Rod 1	23.37 seconds	33 seconds
Safety Rod 2	22.56 seconds	31 seconds
Coarse rod:	27.97seconds	32 seconds
Fine rod:	28.86 seconds	38 seconds

T/S 3.2.c. The safety rods and coarse control rod shall be interlocked such that:

1. Reactor startup cannot commence unless both safety rods and coarse control rod are fully withdrawn from the core.
2. Only one safety rod can be inserted at a time.
3. The coarse control rod cannot be inserted unless both safety rods are fully inserted.

Discussion: The logic controlling the drive motors is such that requirements 1, 2, and 3 are satisfied

T/S 3.2.d. Nuclear safety channel instrumentation shall be operable in accordance with Table 3.1 whenever the reactor control or safety rods are not at their fully withdrawn position.

Table 3.1

Safety Channel	Set Point	Function
Nuclear Safety #1		
Low count rate	>10 cps	scram below 10 cps
Nuclear Safety #2		
High Power	<10 W	scram at power > 10 W
Low Power	> 1.0×10^{-12} amps	scram at source levels < 1.0×10^{-12} amps
Reactor Period	>5 seconds	scram at period < 5 seconds
Nuclear Safety #3		
Linear Power		
High Power	<10 W	scram at power > 10 W
Low Power	> 5% full scale	Scram at source levels < 5% of full scale

Discussion: All of these scrams are part of the safety circuitry and have been fully tested with two exceptions:

First, calibrations, of course, will have to be done to assure that the power readings are correct.
Second, the power displays are autoscaling so there cannot be a low level (<5% full scale) trip. We have not included this scram to avoid having a nonfunctional scram.

T/S 3.2.e. The shield water level interlock shall be set to prevent reactor startup and scram the reactor if the shield water level falls 9.5 inches below the highest point on the reactor shield tank manhole opening.

Discussion: The float switch position has not been changed and the electronics initiates a scram, as before.

T/S 3.2.f. The shield water temperature interlock shall be set to prevent reactor startup and scram the reactor if the shield water temperature falls below 15° C.

Discussion: The temperature sensor is unchanged and the electronics initiates a scram as before.

T/S 3.2.g. The seismic displacement interlock shall be installed in such a manner to prevent reactor startup and scram the reactor during a seismic displacement.

Discussion: The seismic switch has not been altered. The safety circuitry initiates a scram on signal from the seismic indication.

T/S 3.2.h. A loss of electric power shall cause the reactor to scram.
Discussion: Loss of power de-energies the magnets and releases the rods, as before.

The failure of the computer controlling the scram circuit would cause the immediate actuation of scram (fail-safe function). If an equipment malfunction were to occur, such as failure of a nuclear instrument, the reactor would scram on the interlock relay or the scram system which is bounded as described in Chapter 13.1.9 Mishandling or Malfunction of Equipment. The failure of the proper scram operation would cause a power and temperature rise. The core thermal fuse would separate and insert a large amount of negative reactivity which is bounded by the maximum hypothetical accident (2% reactivity insertion) as described in Chapter 13.1.1.

No FSAR and Tech. Spec. modification has been made with the exception of two instrument displays (not functionality). Subsequent console appearance and model name have been replaced in FSAR Chapter 7 as attached in Appendix B. No safety evaluation for the FSAR changes is needed.

Conclusion

The safety evaluation of console instrumentation and electronics upgrade has been reviewed in accordance with 10 CFR 50.59. The modification does not increase the likelihood, frequency or magnitude of the consequences of accidents or malfunctions currently analyzed by the SAR. The modification does not result in a reduction of any safety margins described in the SAR.

Appendix A. Upgraded equipment list

Equipment	Manufacture and model type
P.A.D(Preamp/Amp/Disc)	CANBERRA Model 814A
Log ratemeter	ORTEC 449/449-2
Encoder	NSB-10
Picoammeter	KEITHLEY 486
Alarm control	ORTEC 461
Power supply	ORTEC 478
Nim Bin	ORTEC 4001
Power supply	Sola SDN
Power supply	Sola SFL

Appendix B FSAR changes

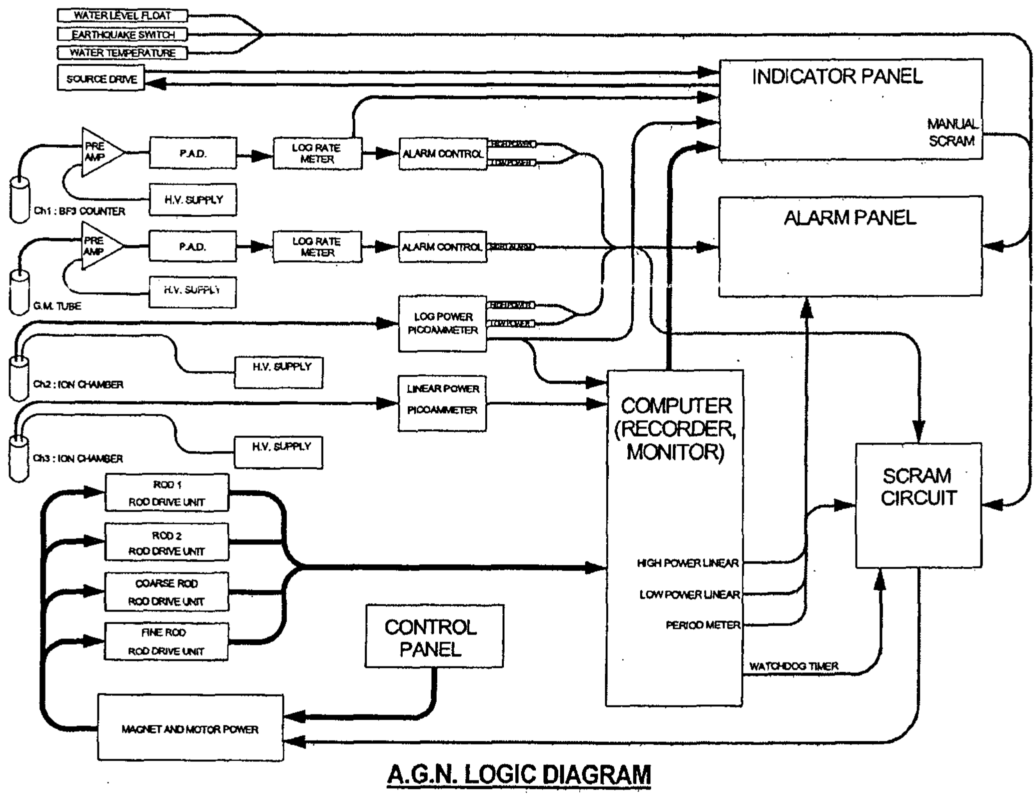


Figure 7.2.1-2 NUCLEAR INSTRUMENTATION SYSTEM

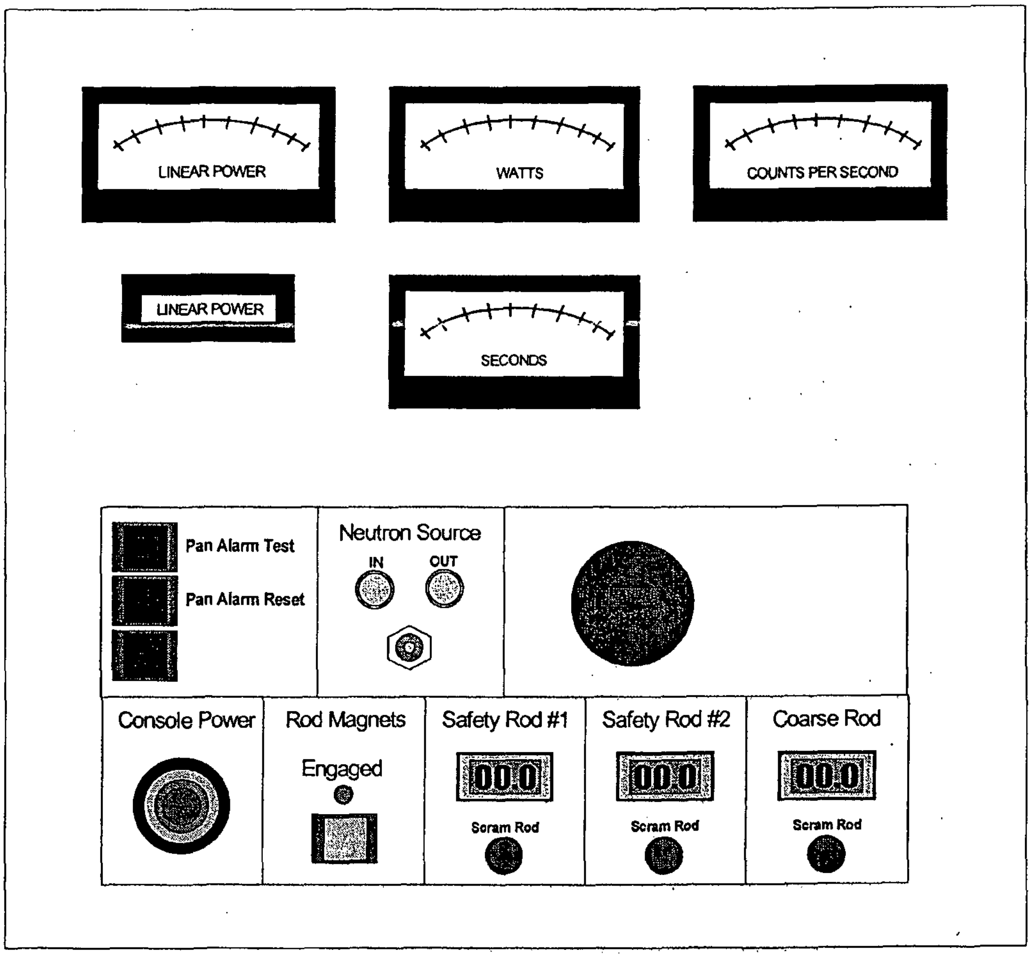


Figure 7.6-2 CHANNEL DISPLAY AND ROD POSITION INDICATORS

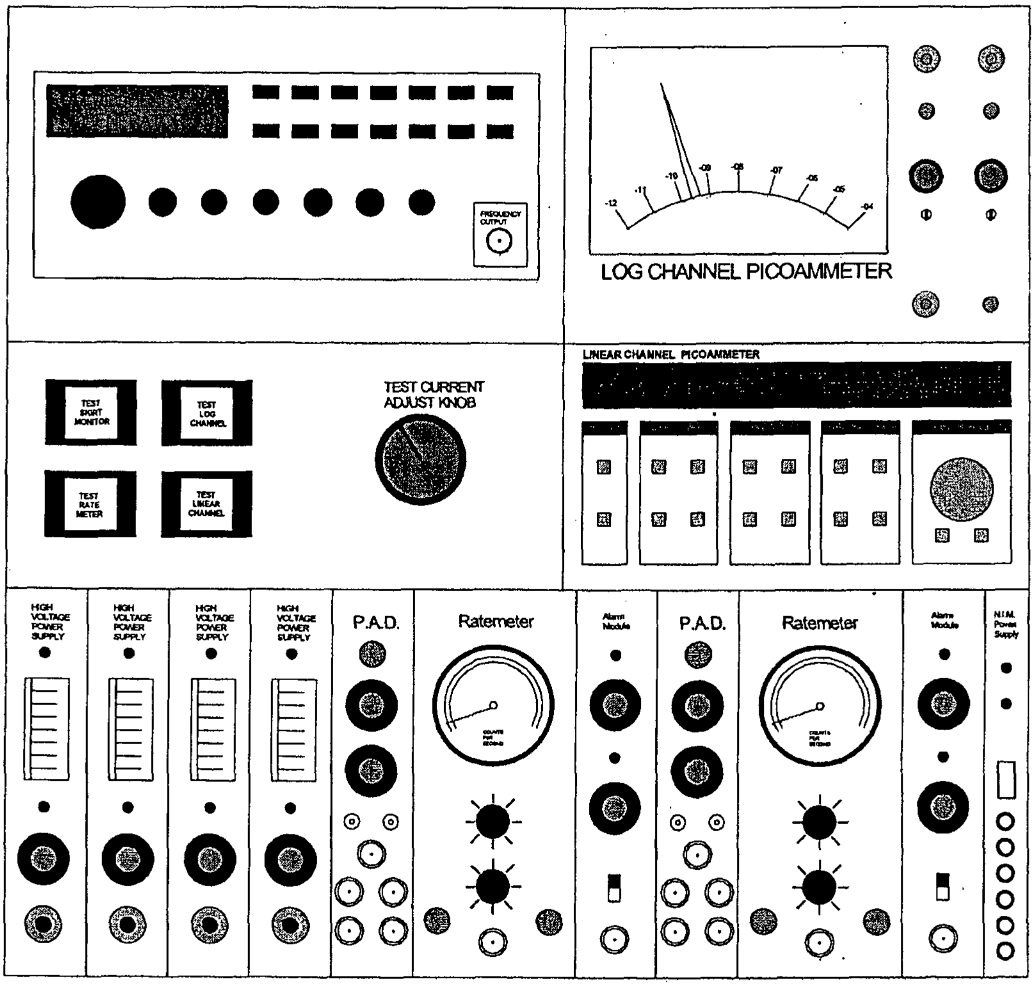


Figure 7.6-3 INSTRUMENT PANEL