

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555-0001

July 1, 1997

**NRC INFORMATION NOTICE 97-44: FAILURES OF GAMMA METRICS WIDE-RANGE
LINEAR NEUTRON FLUX CHANNELS**

Addressees

All holders of operating licenses or construction permits for test and research reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to inform addressees of failures that have occurred in Gamma Metrics wide-range linear neutron flux channels that have the potential to defeat the scram function of the channels. It is expected that recipients will review the information for applicability to their facilities and consider action, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

The non-power reactor at North Carolina State University (NCSU) has two Gamma Metrics wide range linear neutron flux channels. One unit is used as a linear channel for power monitoring and control and provides a high-power-level scram. The other unit is used as a safety channel that provides a high-power-level scram.

The channels used at NCSU can be operated in two modes for ranging and two modes for bistable scram functions. For ranging, these units can be operated (1) in an auto-ranging mode in which the unit changes scales automatically, or (2) in a manual range-change mode in which the reactor operator changes the range displayed on the channel to follow the reactor power level or leaves the channel set on one range. These units can also be operated with the bistable set (1) in the standard mode in which the scram function is present on each range at a set percentage of range, or (2) in a smart mode in which the scram function is present at a set percentage of range on one specific range determined by the operator and all ranges above it. The emphasis of this information notice is on the auto-ranging and smart mode combination.

The initial problem observed by the licensee was that the linear channel unit failed to uprange automatically with the unit in the reactor console in the auto-ranging mode. While testing the unit in the reactor console after repair, the unit failed to uprange and exhibited spurious range-changing while operating in the auto-ranging mode (Accession Number 9702120389). During pre-startup console testing following modification of the unit, it was

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updated 7/17/97



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found that actuation of the rod reverse demand would cause a range change with the range control in manual mode. During benchtop testing following repairs, the unit exhibited spurious range changes, including oscillatory behavior (changing up one level when requested, but then changing back to the original level). It was also observed that the unit increased range to greater than the maximum range even though this unit has by design a maximum range limit function.

The unit used as a safety channel exhibited spurious down ranging during reactor operation in the manual mode with the bistable set in the standard mode.

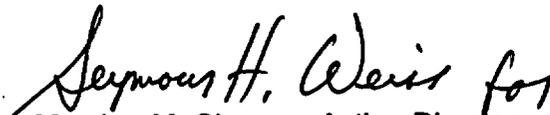
Discussion

It is possible for a malfunction of these units to disable the scram function, which, depending on the use of the unit, may be a high-power-level scram required by the technical specifications (TS). For the scram to be disabled, the unit bistable would have to be in the smart bistable mode while a spurious down ranging occurs, which places the unit on a range without scram protection when such protection is needed. Being on the wrong range disables the scram function because the reactor could be operated beyond the scram setpoint power level. Operating the unit with the bistable in the standard mode with the scram enabled on all ranges alleviates this problem.

If a spurious uprange malfunction occurs in which the range goes beyond the maximum range limit, the scram function, if still present, will actuate with the unit bistable in the standard mode. This result occurs because the invalid range setting forces the picoammeter to a maximum feedback state. This maximum feedback will cause the bistable input to go full scale for any current above 10 picoamperes. For this unit, 10 picoamperes represents either 7 or 8 decades below full power.

The fact that the unit is on an incorrect scale can be readily detected by the reactor operator by observation of the unit display. The operator can then take whatever action is necessary to respond to the specific situation. The impact of this type of problem is reduced by the TS requirement for multiple high-power-level scrams using redundant channels.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below.


Marylee M. Slosson, Acting Director
Division of Reactor Program Management
Office of Nuclear Reactor Regulation

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Information Notice No.	Subject	Date of Issuance	Issued to
97-43	License Condition Compliance	07/01/97	All holders of OLs or CPs for nuclear power reactors
97-42	Management Weaknesses Resulting in Failure to Comply with Shipping Requirements for Special Nuclear Material	06/27/97	All fuel cycle conversion, enrichment, and fabrication facilities
97-41	Potentially Undersized Emergency Diesel Generator Oil Coolers	06/27/97	All holders of OLs or CPs for boiling-water reactors
97-40	Potential Nitrogen Accumulation Resulting from Backleakage from Safety Injection Tanks	06/26/97	All holders of OLs or CPs for pressurized-water reactors
97-39	Inadequate 10 CFR 72.48 Safety Evaluations of Independent Spent Fuel Storage Installations	06/26/97	All holders of OLs or CPs for nuclear power reactors. All holders of licenses for independent spent fuel storage installations
97-38	Level-Sensing System Initiates Common-Mode Failure of High-Pressure-Injection Pumps	06/24/97	All holders of OLs or CPs for nuclear power reactors
96-53, Supp. 1	Retrofit to Amersham 660 Posilock Radiography Camera to Correct Inconsistency in 10 CFR Part 34 Compatibility	06/23/97	All industrial radiography licensees

OL = Operating License
CP = Construction Permit

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The unit used as a safety channel exhibited spurious down ranging during reactor operation in the manual mode with the bistable set in the standard mode.

Discussion

It is possible for a malfunction of these units to disable the scram function, which, depending on the use of the unit, may be a high-power-level scram required by the technical specifications (TS). For the scram to be disabled, the unit bistable would have to be in the smart bistable mode while a spurious down ranging occurs, which places the unit on a range without scram protection when such protection is needed. Being on the wrong range disables the scram function because the reactor could be operated beyond the scram setpoint power level. Operating the unit with the bistable in the standard mode with the scram enabled on all ranges alleviates this problem.

If a spurious uprange malfunction occurs in which the range goes beyond the maximum range limit, the scram function, if still present, will actuate with the unit bistable in the standard mode. This result occurs because the invalid range setting forces the picoammeter to a maximum feedback state. This maximum feedback will cause the bistable input to go full scale for any current above 10 picoamperes. For this unit, 10 picoamperes represents either 7 or 8 decades below full power.

The fact that the unit is on an incorrect scale can be readily detected by the reactor operator by observation of the unit display. The operator can then take whatever action is necessary to respond to the specific situation. The impact of this type of problem is reduced by the TS requirement for multiple high-power-level scrams using redundant channels.

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original signed by S.H. Weiss for
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Tech Editor has reviewed & concurred on 04/19/97

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DATE	6/6/97	04/18/97	06/19/97	06/25/97 <i>[Signature]</i>

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The fact that the unit is on an incorrect scale can be readily detected by the reactor operator by observation of the unit display. The operator can then take whatever action is necessary to respond to the specific situation. The impact of this type of problem is reduced by the TS requirement for multiple high-power-level scrams using redundant channels.

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The unit used as a safety channel exhibited spurious down ranging during reactor operation in the manual mode with the bistable set in the standard mode.

Discussion

It is possible for a malfunction of these units to disable the scram function, which, depending on the use of the unit, may be a high-power-level scram required by the technical specifications (TS). For the scram to be disabled, the unit bistable would have to be in the smart bistable mode while a spurious down ranging occurs, which places the unit on a range without scram protection when such protection is needed. Being on the wrong range disables the scram function because the reactor could be operated beyond the scram setpoint power level. Operating the unit with the bistable in the standard mode with the scram enabled on all ranges alleviates this problem.

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The unit used as a safety channel exhibited spurious down ranging during reactor operation in the manual mode with the bistable set in the "standard" mode.

Discussion

It is possible for a malfunction of these units to disable the scram function, which, depending on the use of the unit, may be a high-power-level scram required by the technical specifications (TS). For the scram to be disabled, the unit bistable would have to be in the "smart" mode while a spurious down ranging occurs, which places the unit on a range without scram protection when such protection is needed. Being on the wrong range disables the scram function because the reactor could be operated beyond the scram setpoint power level. Operating the unit with the bistable in the "standard" mode with the scram enabled on all ranges alleviates this problem.

If a spurious uprange malfunction occurs in which the range goes beyond the maximum range limit, the scram function, if still present, will not actuate at the proper setpoint even with the unit bistable in the "standard" mode. This result occurs because the scram is set for a percentage of the range on all ranges, which will be above the scram setpoint when it is beyond the maximum range. Licensees should be aware of this type of behavior. The impact of this type of problem is reduced by the TS requirement for multiple high-power-level scrams using redundant channels. The possibility of a problem is further reduced if the redundant channels are also diverse.

The fact that the unit is on an incorrect scale can be readily detected by the reactor operator by observation of the unit display. The operator can then take whatever action is necessary to respond to the specific situation.

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