NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

07-191-91

02-REQ-007-353-2-27 Revision 0

TITLE: USNRC REGULATORY GUIDE 1.97; "INSTRUMENTATION FOR LIGHT-WATER-COOLED NUCLEAR POWER PLANTS TO ASSESS PLANT AND ENVIRONS CONDITIONS DURING AND FOLLOWING AN ACCIDENT"

	SIGNATURE	DATE
PREPARER	Clint D. Sherman	1-29-91
TRAINING AREA SUPERVISOR	[signature]	2-4-91
TRAINING SUPPORT SUPERVISOR	[signature] for J. LaClair	2-4-91
PLANT SUPERVISOR/ USER GROUP SUPERVISOR	[signature]	2/6/91

Summary of Pages

(Effective Date: 2-4-91)

Number of Pages: 33

Date	Pages
January 1991	1 - 33

TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY:

VERIFICATION

DATA ENTRY

RECORDS

I. TRAINING DESCRIPTION

A. Title of Lesson: USNRC Regulation Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident".

B. Lesson Description: Provide instruction in the purpose and requirements of NRC Reg. Guide 1.97 and the specific application to the Nine Mile Point Unit Two Reactor Plant.

C. Estimate of the Duration of the Lesson: 2 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation: Written Exam Passing grade of 80% or greater.

E. Method and Setting of Instruction: This lecture/facilitated discussion should be conducted in the classroom.

F. Prerequisites:

1. Instructor:
   a. Qualified for the material being delivered in accordance with NTP-16, Attachment A.
   b. Qualified in instructional skills as certified by NTP-16.
2. Trainees:
   a. Qualified for the course in accordance with NTP-11.

G. References:

1. Reg. Guide 1.97
2. N2-OLT-05, "Reactor Vessel Instrumentation"
3. N2-OLT-23c, "Containment Atmosphere Monitoring System"
4. N2-OLT-61, "Meteorological Monitoring System"
5. N2-OLT-62, "Radiation Monitoring System"
6. N2-OLT-63, "Post Accident Sampling"
7. Procedure N2-OP-34, "Nuclear Boiler, Automatic Depressurization and Safety Relief Valves
8. Procedure N2-OP-82, "Containment Monitoring System"
9. TCO-02-REQ-90-084

II. REQUIREMENTS

A. Requirements for class:

1. NTP-11

III. TRAINING MATERIALS

A. Instructor Materials:

1. Whiteboard, markers, erasers
2. Transparencies
3. Overhead Projector
4. Working Copy of this Lesson Plan
5. Student Text
6. Training Record
7. Course Evaluation Form

B. Trainee Materials:

1. Text (including Reg. Guide 1.97)
2. Pens, pencils, paper

IV. EXAM AND MASTER ANSWER KEYS

Exams and master answer key(s) filed with the official records.

V. LEARNING OBJECTIVES

Upon completion of this training, the trainee will have gained the knowledge to:

A. Terminal Objectives:

TO-1.0 Use NRC Regulatory Guide 1.97 and Nine Mile Point Unit Two procedures (and other plant documentation) to evaluate the requirements of the Reg. Guide and demonstrate how these requirements are applied in the process instrumentation of NMP-2.

B. Enabling Objectives:

EO-1.0 Describe the five distinct categories of plant parameter indications required by the Reg. Guide to provide information to the Control Room Operators during accident situations.

EO-2.0 Explain the reason why instrumentation associated with the challenge against the integrity of barriers to the release of radioactive materials must always be "on-scale" and how it is accomplished for select NMP-2 process variables.

EO-3.0 Briefly explain the concepts of Class 1E environmental qualification and seismic qualification and why accident instrumentation must be so qualified.

EO-4.0 Evaluate the NRC recommendation that it is "prudent to select the required accident-monitoring instrumentation from the normal power plant instrumentation" and determine how this concept is applied at NMP-2.

EO-5.0 Explain the five types of variables so categorized for the purpose of aiding the designer in selecting accident - monitoring instrumentation and applicable criteria.

EO-6.0 Discuss differences and changes in instrumentation requirements in Reg. Guide 1.97 revision 3 (as compared to revision two) as stated in the "Regulatory Analysis" section of this document.

EO-7.0 Using NRC Regulatory Guide 1.97, determine the "Design and Qualification Criteria for Instrumentation" for a given variable as established in Table one of Reg. Guide 1.97.

EO-8.0 Using NRC Regulatory Guide 1.97, determine the "type variable" (A, B, C, D or E) category a given plant parameter falls under and the design and qualification criteria applicable as established in Table Two of Reg. Guide 1.97.

C. Objective relationship to NMP2 task analysis:

TO-1.0 - Use NRC Regulatory Guide 1.97 and Nine Mile Point Unit Two procedures (and other plant documentation) to evaluate the requirements of the Reg. Guide and demonstrate how these requirements are applied in the process instrumentation of NMP-2.

a. 3430250303 Maintain knowledge of modifications to safety related equipment.

I. INTRODUCTION

A. Introduction

1. Distribute Training Report and ensure its completion.
2. Discuss the Course Evaluation Form and its purpose. Request the trainees complete them at the end of the course.
3. Explain the method of evaluation (coverage of the topic will be on the weekly exam).
4. Discuss lesson objectives
5. Purpose
   a. To provide instruction in the purpose and requirements of NRC Regulatory Guide 1.97 and the specific application to the Nine Mile Point Unit Two reactor plant.

6. General Description

   a. NRC Regulatory Guide 1.97 is a post-TMI document intended to establish specific guidelines for reactor plant instrumentation qualification. The intent is to ensure that all necessary parameter indication for normal and accident conditions is available to the operators in the full range of possible conditions so that information is available to them sufficiently to permit them to operate as safely as possible and to be reasonably sure that the indication of the parameters is accurate.

B. NRC Regulatory Guide 1.97

   1. Section A, "Introduction"

      a. 10CFR50, Appendix A requires that "instrumentation be provided to monitor variables and systems over their anticipated ranges for accident conditions as appropriate to ensure adequate safety".

This lesson is setup to follow the material in Reg. Guide 1.97 as it appears in order. The students will be using Reg. Guide 1.97 as their text.
(This quote is from Reg. Guide 1.97)

b. 10CFR50, Appendix A also requires a Control Room where actions to place the plant in a safe condition during an accident can be performed. Also requires equipment and instrumentation for shutdown outside the Control Room capability.

c. 10CFR50, Appendix A also requires a means be provided for monitoring containment atmosphere, spaces containing components for recirculation of LOCA fluids effluent discharge paths, and plant environs for radioactivity that may be released from postulated accidents.

d. Reg. Guide 1.97 describes a method acceptable to the NRC for complying with Commission Regulations for plant instrumentation. (Advisory Committee on Reactor Safeguards has concurred).

2. Section B, "Discussion"

a. Indications of plant variables are required by Control Room personnel during accidents to:

EO-1.0

1) Provide information to allow operator to take pre-planned manual actions to accomplish safe plant shutdown.

2) Determine if reactor trip, engineered safety feature, manually initiated safety systems (other systems important to safety) are performing intended functions.

Examples would be:
- Reactivity control
- Core cooling
- Maintaining RCS integrity
- Maintaining containment integrity

3) Provide information to operators to enable them to determine the potential for causing a gross breach of barriers to radioactivity release (and determine if such a breach has occurred).

Examples would be:
- Fuel cladding
- Rx coolant press boundary
- Containment boundary

b. In addition to the above, indications of plant variables that provide information on operation of plant safety systems and other systems important to safety are required by Control Room operating personnel during an accident to:

1) Furnish data regarding the operation of plant systems in order that the operator can make appropriate decisions as to their use.
2) Provide info. regarding release of radioactive materials to allow for early indication of need to initiate action to protect the public and to estimate magnitude of any impending threat.

c. At the start of an accident, it may be difficult for the operator to determine what accident has occurred or is occuring and therefore determine the appropriate response.

For this reason, reactor trip and certain other safety functions (ECCS, PCIS, ADS) have been designed to operate automatically in response.

Need to point out that, although this concept is correct, the operating concept of the Emergency Operating Procedures (EOPs) has made it unimportant to diagnose events in order to respond to the conditions.

Instrumentation is also provided to indicate information about plant variables required to enable the operation of manually initiated safety systems and other appropriate operator actions involving systems important to safety.

d. Independent of above tasks, operators must be informed if barriers to release of radioactive materials are being challenged. Therefore, instrument ranges should be selected so the parameter always indicates on-scale.
   1) May require multiple ranges on more than one instrument.
   2) Overlapping ranges should be used.
   3) Instrumentation must be able to survive the accident it is designed for use during (and after).
      a) By design
      b) By environmental enclosure

EO-2.0

Q: What types of events could lead to a challenge of barriers to release of radioactive materials?

A: LOCA, ATWS (others)

DW pressure is multiple range (normal and accident ranges).

	4) "Functionally significant" (ie: RPV pressure, containment pressure) variables should be monitored by instruments qualified to more stringent environmental requirements with ranges extending beyond that which would be reached under limiting conditions.	Example: DW press ind. must be greater than design pressure.	
e.	Accident - monitoring instruments (and components) should be seismically qualified or able to function as intended following a seismic event.	One way to enhance seismic resistance is to design the system as you would if it were to be seismically qualified in a seismically qualified building (assuming here that the building is not seismically qualified).	EO-3.0
f.	Instruments must maintain their accuracy when indicating in the extended range.		

g. Normal instrumentation still functioning following an accident condition can provide indication, records and time - history (some instruments). Therefore, it is prudent to select the required accident - monitoring instrumentation from the normal power plant instrumentation to enable operators to use the most familiar instruments during accident conditions.

1) In some cases, plants will have to upgrade normal plant instruments to be used this way. (Qualification requirements more stringent).

2) Any instrument upgrades must not compromise accuracy and sensitivity of the normal operating ranges.

a) Overlapping ranges may be used to preclude this (each range may have different sensitivity and accuracy bands).

Q: How is the concept of "selecting required accident-monitoring equipment from the normal power plant instrumentation" implemented at NMP-U2? EO-4.0

A: Post-accident instrumentation is located on P601 and is part of the normally used instrumentation.

Example:
In several older plants, mechanical pressure switches have been replaced by analog trip devices (such as Rosemounts) in order to upgrade normal instrumentation.

h. ANSI standard ANS-4.5 (1980) delineates criteria for determining the variables to be monitored by the Control Room Operator during an accident and during the long-term stable shutdown phase that follows.
The ANSI determination was based on two primary objectives:
1) To address the instrumentation that permits the operators to monitor expected parameter changes in an accident period.
2) To address extended - range instrumentation deemed appropriate for the possibility of encountering previously unforeseen events.

i. ANS-4.5 defines three types of variables for the purpose of aiding the designer in selecting accident monitoring instrumentation and applicable criteria.

EO-5.0

Refer to Table 2 to see the type variables.

1) TYPE A - "Those variables that provide primary information needed to permit Control Room operating personnel to take the specified manually controlled actions for which no automatic control is provided and that are required for safety systems to accomplish their safety functions for design basis accident events."

Primary Information -
Information essential for the direct accomplishment of the specified safety functions (it does not include those variables that are associated with contingency actions that may also be identified in written procedures).

Examples of TYPE A:
- Turbine 1st stage press.
- Condenser vacuum
- DW pressure (before 1.68# occurs).

2) Type B - "Those variables that provide information to indicate whether plant safety functions are being accomplished."

Plant safety functions:
- Reactivity control
- Core cooling
- Maintaining Reactor Coolant System integrity.
- Maintaining containment integrity (including radioactive effluent control).

See Table 2 for Type B variables.

3) Type C - "Those variables that provide information to indicate the potential for being breached or the actual breach of the barriers to fission product release."

Barriers:

- Fuel cladding
- Primary coolant pressure boundary
- Containment

See Table 2 for Type C variables.

j. In addition to the "accident-monitoring" variables provided in ANS-4.5 (afore - mentioned), variables for monitoring the operation of systems important to safety and radioactive effluent releases are provided by Reg. Guide 1.97.

Two additional variable types are defined:

1) Type D - "Variables that provide information to indicate the operation of individual safety systems and other systems important to safety."

These variables are to help the operator make appropriate decisions in using the individual systems important to safety in mitigating the consequences of an accident.

See Table 2 for Type D variables.

	2) Type E - "Variables to be monitored as required for use in determining the magnitude of the release of radioactive materials and for continuously assessing such releases."	See Table 2 for Type E variables.
k.	Reg. Guide 1.97 provides a <u>minimum</u> set of Type B, C, D and E variables. The Type A variables aren't listed because they are plant specific and will depend on the operations that the designer chooses for planned manual action.	
	1) Type B, C, D and E are variables for following the course of an accident are to be used:	
	a) To determine if the plant is responding to the safety measures in operation.	
	b) To inform the operator of the necessity for unplanned actions to mitigate the consequences of an accident.	Again, this concept is improved through the use of EOPs.
l.	The 5 classifications are not mutually exclusive.	Example: Drywell Pressure satisfies types A, B, C and D.

1) A given variable (or instrument) may be applicable to one or more types, as well as for normal plant operation.

2) If an instrument is used in more than one type classification, it must satisfy the most stringent requirements.

m. Design and qualification criteria for the instrumentation is established in Table 1. References to Table 1 are given for the individual instruments in Table 2.

Table 1 will be discussed separately.

1) Category 1 - the most stringent requirements is intended for "key variables".

Key variable - that single variable (or minimum number of variables) that most directly indicates the accomplishment of a safety function (for Types B and C) or the operation of a safety system (for Type D) or radioactive material release (for Type E).

2) Category 2 - less stringent; generally applies to instruments designated for indicating system operating status.

3) Category 3 - provides requirements to ensure that high-quality off-the-shelf instrumentation is obtained and applies to backup and diagnostic instrumentation. Also used where the state of the art equipment will not support requirements for higher qualified instrumentation.

n. A single key variable may not be enough to indicate the accomplishment of a given safety function.

1) If multiple variables are needed for a given safety function:

a) Each must be considered a key variable.

b) Appropriate quality of instrumentation applicable.

2) Backup instrumentation to the key variables may be used.

a) Design, qualification and QA of backups doesn't have to match that of a key variable.

o. Typically:

1) For instrument types B and C:

a) Key variables are category 1

b) Backups are category 3

2) For instrument types D and E:
   a) Key variables are category 2
   b) Backups are category 3

p. Variables listed, but no mention made of number of points of measurement of each variable (except for redundancy requirements).
   1) Number of points of measurement must be adequate to indicate the variable value.
      a) Example - containment temperature may require spatial location of several points of measurement.

q. Reg. Guide 1.97 provides the <u>minimum</u> number of variables to be monitored by CR operators during and following an accident.

r. Purpose of these selected "minimum" variables
   1) Give CR operators info to perform EP evaluation, assessment, monitoring, and execution of CR functions when no other Emer. Resp. facilities are manned.

2) Permit operator long-term monitoring and execution responsibilities after Emer. Resp. facilities are manned.

s. Application of instrumentation criteria is pertinent to all the parts related to the direct display of variables.

Related to direct display
- Power supply
- Vital support features
- Sensing
- Interpreting
- Displaying

t. Application of instrumentation criteria is not necessarily pertinent to peripheral functions of the instruments intended to enhance information presentation for identification or diagnosis of disturbances.

Peripherals
- Computer displays
- Annunciators/alarms

3. Section C, "Regulatory Position"

a. This section basically states that Reg. Guide 1.97 considers the requirements of ANSI/ANS-4.5 - 1980 to be generally acceptable for providing instrumentation to monitor variables for accident conditions, with exceptions:

1) IEEE Std 497 - 1977 (referenced in ANS - 4.5) has not had its specific applicability/acceptability determined yet.

2) Definitions for Type A and Type C variables have been changed to apply specifically to reactor power plants.

Type A definition changed completely. Type C definition modified (review the definitions)

3) Design and qualification requirements for nuclear plant instrumentation are provided in Table 1 of Reg. Guide 1.97, rather than in ANS - 4.5!

b. Table 2 is to be considered as the minimum number of instruments and their respective ranges for accident - monitoring instrumentation for each nuclear power plant.

It is also the minimum standard for safety system monitoring (Type D) and radioactivity release (Type E) instrumentation.

c. Type D and Type E instruments are included in Reg. Guide 1.97 (Although not a part of ANS - 4.5) for monitoring of safety systems and radioactive releases.

Review the definitions of Type D and Type E variables.

1) The process for selecting system operation and effluent release variables should include the identification of:

a) For Type D

- The plant safety systems and other systems important to safety that should be operating or that could be placed in operation to help mitigate the consequences of an accident; and
- The variable or minimum number of variables that indicate the operating status of each system identified in (1) above.

b) For Type E

- The planned paths for effluent release;

- Plant areas and inside buildings where access is required to service equipment necessary to mitigate the consequences of an accident;
- Onsite locations where unplanned releases of radioactive materials should be detected; and
- The variables that should be monitored in each location identified (above)

4. Section "Regulatory Analysis" (This section deals primarily with differences between older revisions and revision 3 of Reg. Guide 1.97)

EO-6.0

   a. Each licensee is required by NRC regulations to provide instrumentation to:

      1) Monitor variables and systems over their anticipated ranges for accident conditions as appropriate to ensure adequate safety.

2) Monitor the reactor containment atmosphere; spaces containing components for recirculation of LOCA fluids, effluent discharge paths, and plant environs for radioactivity that may be released from postulated accidents.

b. The modifications of revision 3 to Reg. Guide 1.97 deal with modifications based on the results of studies pertaining to radiation monitors, further evaluation of meteorological measurements and initial input from independent evaluation of the overall clarity of the guide.

1) The original guide included requirements for fixed location environs radiation monitoring equipment.

2) The industry and the Advisory Committee on Reactor Safeguards questions the practicality of this requirement.

3) A study concluded that the fixed environs monitors could not provide sufficiently reliable information to be of use in detecting releases from unmonitored containment release points.

4) NRC agreed with this and removed requirements for the fixed monitors from Reg. Guide 1.97.

5) Requirements for exposure rate monitors, other than those inside buildings where access is required to service equipment important to safety, have been deleted.

6) NRC removed requirements for high accuracy of the containment radiation monitors, since correction factors can be applied to compensate for the energy spectrum.

7) Reg Guide 1.97 meteorological instrumentation requirements have upgraded to reflect Reg. Guide 1.23, "Meteorological Programs in support of Nuclear Power Plants', which had some what more stringent requirements.

8) Design and Qualification Criteria (categories 1, 2, and 3 in table 1) are in an easier to read format.

9) "Range" provisions were changed in the tables of variables to make them consistent.

10) Printing/editing errors corrected

11) Clarification of the "discussion" and "regulatory position" sections of the guide.

5. Table One, "Design and Qualification Criteria for Instrumentation." EO-7.0

a. This section will be covered by transparencies of each section of table one, in sequence, with the instructor reviewing the individual equipment qualification requirements.

TP - 1 (Page 1.97-5)
TP - 2 (Page 1.97-6)
TP - 3 (Page 1.97-7)
TP - 4 (Page 1.97-8)
TP - 5 (Page 1.97-9)
TP - 6 (Page 1.97-10)
TP - 7 (Page 1.97-11)

6. Table Two "BWR Variables"

a. Type A variables

1) Definition of

2) "Primary information"

3) Examples:

a) DW pressure

b) RPV water level

c) Condenser Vacuum

d) RCIC flow

4) None listed in Reg. Guide 1.97 because of the plant specific nature of these variables.

5) All are to be Category 1 instruments (from Table 1 of Reg. Guide 1.97).

Repeat the definition of Type A variables

or

Ask the question "What is a Type A variable" (per Reg. Guide 1.97)?

Answer:

See Page 1.97-13 in Reg. Guide 1.97.

EO-8.0

Q: "What is primary information"?

A: See Page 1.97-13 in Reg. Guide 1.97.

b. Type B variables

1) Definition of ...

2) Plant safety functions

Repeat definition of Type B variables or

Ask the question:

"What is a Type B Variable" (per Reg. Guide 1.97)?

A: See page 1.97-13 in Reg. Guide 1.97

Q: "What are plant safety functions"?
A: See page 1.97-13 in Reg. Guide 1.97

3) Key variables are those indicated by design and qualification Category 1.

Q: What is a "key variable"?
A: See para. 7 on page 1.97-3 in Reg. Guide 1.97.

4) Reactivity Control

a) Neutron Flux

i. SRM

- 10^{-1} to 10^{6} cps
- Monitors power level down to approx. $10E^{-9}$ percent

TP-8
Show page 1.97-13
Table Two - Discuss the
- Variable
- Range
- Category (Table 1)
- Purpose

for each variable in sequence, along with the NMP-U2 instrumentation actually used.

ii. IRM

- Range 1 to range 10
- Monitors power level from approx. 10^{4} cps (SRM) to approx. 50 percent power.

iii. APRM

- 0 to 125 percent power indication

b) Control Rod Position

i. Reed switches

c) RCS Soluble Boron Concentration (Grab sample)	
	Actual levels
5) Core Cooling	<u>(above bottom zero)</u>
a) RPV water level	366.31" = TAF
i. Fuel zone range of -165" to 35" reaches below the bottom of the core support plate.	215.31" = min. water level indication
b) BWR Core Temperature	See Inspection Report for Reg. Guide 1.97 (attached in Student Test).
i. Not enforced to date as further development is required.	
6) Maintaining Reactor Coolant System Integrity	
a) Reactor Coolant System pressure	
b) Drywell pressure	
i. Low range - 5 to +5 psig.	
ii. High range 0 to 150 psig.	
c) Drywell Sump Levels	TP-9, page 1.97-14
i. 0-100% (for both equip & floor tanks) on panel P873.	

Exhibit 1

Affidavit Regarding Texas Driver's License

7) Maintaining Containment Integrity

a) Primary Containment Pressure

i. -5 to design psig.

ii. Multi-purpose instrumentation

b) Primary Containment Isolation Valve position (excl. check vlvs)

i. Methods of PCIS valve position.

- Limit switches (red--green lights on control panels)
- Amber lights (isol. signal received/sealed)

Examples:

- MSIVs
- Cont Atm Control Valves

C. Type C variables

1. Definition of...

Repeat defer of Type C variables or ask the question...

"What is a Type C variable"? (Per Reg. Guide 1.97.)

A: See page 1.97-14 in Reg. Guide 1.97.

2. "Barriers" to fission product release

Q: What are the barriers to fission product release?

A: - Fuel cladding
- Primary coolant press boundary
- Containment

[illegible]

[illegible]

[illegible]

3. Fuel Cladding	Again, only the category one variables will be discussed in depth.
a. Radioactivity Concentration or Radiation Level in Circulating Primary Coolant.	
1) Coolant sampling	ATWS pressure trip setpoint: 1050 psig
4. Reactor Coolant Pressure Boundary	
a. RCS Pressure	TP-10
b. Drywell Drain Sumps Level (identified and unidentified leakage).	Page 1.97-15
c. Suppression Pool Water Level	ECCS Suctions
1) NR - 198' to 202'	(Top of suction strainer inlets)
2) WR - 192' to 217'	LPCI - 189'x 8" Numbers are from LPCS - 188'2" USAR 6.3 (ECCS) HPCS - 189'8"
	Minimum drawdown water level = 197'8".
d. Drywell Pressure	
5. Containment	
a. RCS Pressure	
b. Primary Containment Pressure	
1) -5 psig to:	
• 3x design (concrete)	Containment design pressure: 45 psig
• 4x design (steel)	
2) Actual -5 to 150 psig	

c. Containment and Drywell H_2 concentration.
   1) 0 to 30 percent volume (-5 psig to design)

d. Containment and Drywell O_2 concentration
   1) 0-10 percent volume (-5 psig to design)

P601:

Containment H_2
- 0-30% (Div. One)

P898

Containment H_2
- 0-30% (Div. Two)

Containment O_2
- 0-10% (Div. Two)

Repeat defn of type D variable or ask the question:
"What is a Type D variable"?
A: See Page 1.97-16

TP-11
Page 1.97-16

TP-12
Page 1.97-17

TP-13
Page 1.97-18

e. Type D variables

1) Definition of..

Repeat defn of type E variables or ask the question:
"What is a Type E variable"?
A: See page 1.97-18

TP-14
Page 1.97-19

TP-15
Page 1.97-20

TP-16
Page 1.97-21

VII. SUMMARY

A. Review Objectives

B. Answer Any Questions