NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS Ø7-187-91

LESSON PLAN

TRANSIENT ANALYSIS

02-LOT-ØØ4-352-2-Ø1

Prepared By: Unit #2 Training Department

APPROVALS	SIGNATURES	DATE AND INITIALS REVISION 1
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Summary of Pages

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NIAGARA MOHAWK POWER CORPORATION

DATE RECEIVED: 2/3/89
DEPT: U2 OPS TRAINING
NAME: M. CARPENTIER
EXTENSION: 1310

Attachment "A"

OBJECTIVE APPROVAL

Author: UNIT II OP's TRAINING

Training Dept: Unit II OPS.

Lesson Title: Transient Analysis

Lesson Plan #: NZ-OLP-100

Training Setting(s): Classroom

Purpose: Instructor shall present information for the student to meet each Student Learning Objective. Additionally, he shall provide sufficient explanation to facilitate the student's understanding of the information presented.

Trainee Job Title: LICENSED OPERATOR CANDIDATE
NON-LICENSED OPERATOR TRAINING
LICENSED OPERATOR REQUALIFICATION

Approvals/Review	Signatures	Date
Training Supervisor	[signature]	2/10/89
Plant Supervisor	R H Smith	2/23/89
Training Analysts Supervisor	J. LeClair for D. Gardner	2/6/89

When complete, attach this form to the master lesson plan.

I. TRAINING DESCRIPTION

A. Title: N2-OLP-100, Transient Analysis

B. Purpose: In a lecture presentation, the instructor shall present information for the student to meet each Student Learning Objective. Additionally, he shall provide sufficient explanation to facilitate the student's understanding of the information presented.

C. Duration of Training: Approximately

D. Training Methods:

- Classroom Lecture
- Assign the Student Learning Objectives as review problems with the students obtaining answers from the text, writing them down and handing them in for grading.

E. References: 1

1. Technical Specifications
   Various
2. Procedures
   None
3. NMP-2 FSAR
   a. Chapter 15

II. REQUIREMENTS AND PREREQUISITES

A. Requirements for Class: 1

1. AP-9, Rev. 2, Administration of Training
2. NTP-10, Rev. 4, Training of Licensed Operator Candidates
3. NTP-11, Rev. 5, Licensed Operator Retraining and Continuing Training
4. NTP-12, Rev. 3, Unlicensed Operator Training

B. Prerequisites:

1. Instructor
   a. Demonstrated knowledge and skills in the subject, at or above the level to be achieved by the trainees, as evidenced by previous training or education, or

b. SRO license for Nine Mile Point Unit II or a similar plant, or successful completion of SRO training including simulator certification at the SRO level for Nine Mile Point Unit II, and

c. Qualified in instructional skills as certified by the Training Analyst Supervisor.

2. Students

a. Meet eligibility requirements per 10CFR55, or

b. Be recommended for this training by Operations Superintendent, his designee, or Training Superintendent.

III. TRAINING MATERIALS

A. Teaching Materials

1. Transparency Package
2. Overhead Projector
3. Whiteboard and Felt Tip Markers
4. N2-OLP-100
5. NMP2 FSAR, Chapter 15 |1
6. See Section I.E.1
7. See Section I.E.2

B. Student Materials

1. FSAR, Chapter 15 |1
2. See Section I.E.1
3. See Section I.E.2
4. Transient Analysis Handout

IV. EXAMINATIONS, QUIZZES AND ANSWER KEYS

Will be generated and administered as necessary. They will be on permanent file in the Records Room.

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 1 TRANSIENT ANALYSIS

Given the reactor at 100% power, state the changes in the major plant parameters that would result from a decrease in reactor water temperature.

100-1.1 Describe the response of all three reactivity coefficients to a decrease in reactor water temperature.

100-1.2 List the instrumentation provided in the Control Room that would be affected by increased core subcooling.

100-1.3 Provided the accident analysis graphs for the identified cause of increased core subcooling describe the reasons for the parameter deviations.

100-1.4 List the expected sequence of events for the various causes of a decrease in reactor water temperature.

VI. LESSON CONTENT

Lesson Content	Text Ref. Page	Text Ref. Fig.	S.L.O.	
I. **INTRODUCTION**				
Student Learning Objectives		1-1		
A. A decrease in reactor water temperature results in:				
1. decrease in voids				
2. increase in neutron moderation				
3. increase in reactor power				
II. **DISCUSSION**				
A. Loss of Feedwater Heating				
1. Possible causes:				
a. steam extraction line to heater is closed				
b. steam is bypassed around heater				
2. The event is analyzed for a decrease of 100°F.				
3. The following sequence of events occur:			1,2	|1
a. 100°F reduction in feedwater temp.				
b. power level and steam flow increase				
c. APRM scram				
d. TCV's regulate pressure				
e. high water level initiates:				
1. turbine trip				
2. feed pump trip				
f. recirc. pump trip on TGV closure 1-2	1-2			
g. TBV regulate pressure				
4. Compare Fig. 1-A to sequence of events, explain deviations		1-A		|1
B. Feedwater Controller Failure-Maximum Demand				
1. Caused by feedwater controller forced to its upper limit				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
2. The following sequence of events occur:			1.4	|1
a. feedwater controller failure				
b. TBV start to open				
c. high level causes RPT and turbine trip, feedpump trip				
d. reactor scram - TSV position				
e. TBV start to open				
f. relief valves actuate				
g. relief valves close				
3. Compare Fig. 1-B with sequence of events, explain deviations		Fig.1-B		|1
C. Pressure Regulator Failure-Open	1-3			
1. Pressure regulate fails resulting in 130% of rated steam flow				
2. The following sequence of events occur:			1.4	|
a. regulator failure				
b. TCV's open wide				
c. TBV's partially open				
d. high water level trips turbine and feedpumps				
e. Rx. scram and RPT-TSV position				
f. relief valves actuate				
g. relief valves close				
h. MSIV isolation (<825 psig)				
i. RCIC and HPCS initiate	1-4			
j. MSIV's closed				
3. Compare Fig. 1-C with the sequence of events, explain deviations		Fig.1-C		|1
D. Inadvertant SRV Opening				
1. SRV opens due to:				
a. valve malfunction				
b. operator initiation				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
2. The following sequence of events occurs:			1.4	1
a. SRV opens				
b. full flow established				
c. new steady state conditions reached				
3. TCV's respond to pressure change				
a. Rx pressure stabilizes at a slightly lower value				
E. Inadvertant RHR S/D Cooling Operations	1-5			
1. Caused by mis-operation of the heat exchangers				
2. The following sequence of events occurs:			1.4	1
a. RHR S/D cooling inadvertantly actuated				
b. slow rise in Rx power				
c. operator correction or Rx scram eventually				

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 2 TRANSIENT ANALYSIS

Given the reactor at 100% power, state the changes in the major plant parameters that would result from a decrease in reactor water temperature.

100-2.1 Describe response of all three reactivity coefficients to an increase in reactor pressure.

100-2.2 List the instrumentation provided in the Control Room that would be affected by an increase in reactor pressure.

100-2.3 Provided the accident analysis graphs for the identified cause of an increase in reactor pressure describe the reasons for the parameter deviations.

100-2.4 List the expected sequence of events for the various causes of an increase in reactor pressure.

VI. LESSON CONTENT

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
I. INTRODUCTION				
Student Learning Objectives				
A. Rx pressure increases	2-1			
1. Voids collapse				
2. Neutron moderation increases				
3. Power increases				
II. DISCUSSION				
A. Pressure Regulator Failure-Closed				
1. Controlling regulator closes TCV's				
2. Back-up regulator takes over				
3. No other auto-actuations expected				
B. Generator Load Rejection-With Bypass				
1. Grid disturbance causes significant loss of electrical load				
2. The following sequence of events occurs:	2-2		2.4	|1
a. loss of electric load				
b. turbine trip				
c. Rx scram and RPT				
d. TCV's closed				
e. TBV's open				
f. relief valves cycle, then close				
3. Compare Fig. 2-B with sequence of events, explain deviations		Fig.2-B	2.3	|1
C. Generator Load Reject-W/O Bypass	2-2			
1. The cause for this event is the same as B above				
2. The sequence of events are as follows:			2.4	
a. loss of electric load				
b. turbine trip				
c. TBV fail to open	2-3			
d. Rx scram and RPT				
e. TCV's closed				
f. relief valves cycle, then close				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
3. Compare Fig. 2-C with sequence of events, explain deviations		Fig.2-C	2.3	
D. Turbine Trip with Bypass	2-3			
1. Caused by one of may auto-signals				
2. The following sequence of events occurs:			2.4	|1
a. turbine trip-TSV's closing				
b. TBV operates				
c. Rx scram and RPT-TSV position				
d. TSV's closed				
e. TBV's regulate pressure				
f. relief valves cycle, then close				
3. Compare Fig. 2-D with the sequence of events, explain deviations		Fig.2-D	2.3	|1
E. Turbine Trip W/O Bypass	2-4			
1. Cause is same as for Section D of this chapter				
2. Expected sequence of events are as follows:			2.4	|1
a. turbine trip				
b. TBV's fail				
c. Rx scram and RPT-TSV position				
d. TSV's closed				
e. relief valves cycle, then close				
3. Compare Fig. 2-E with events and explain deviations			2.3	|1
F. MSIV	2-5			
1. Causes result from numerous auto-signals or operator actions				
2. The sequence of events are as follows:			2.4	|1
a. all MSIV's start closing				
b. MSIV position scram				
c. RPT on dome pressure				

Lesson Content	Text Ref. Page	Text Ref. Fig.	S.L.O.	
d. group 1 relief valves start to open				
e. all MSIV's go closed	2-6			
f. all relief valves cycle, and then close				
3. Compare Fig. 2-F to the events and explain the deviations		Fig.2-F	2.3	|1
G. Loss of Condenser Vacuum				
1. The following can cause a loss of condenser vacuum:				
a. failure of air ejectors				
b. loss of steam seals				
c. vacuum bkr. openings				
d. loss of 1 or more circ. pumps				
2. The sequence of events are as follows:			2.4	|1
a. initiate loss of condenser vacuum at 2 in. Hg/sec				
b. turbine trip	2-6			
c. Rx scram RPT-TSV position				
d. TSV's closed, TBV's regulate press				
e. relief valves open (all)				
f. feed pumps trip on high level				
g. MSIV's and TBV's start to close on low vacuum				
h. group 5 relief valves start to close				
i. TBV's closed				
j. all relief valves closed				
k. MSIV's closed				
l. relief valves cycle to regulate pressure				
3. Compare Fig. 2-G to the events and explain deviations		Fig.2-G	2.3	|1

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
H. Loss of Normal Station Service and Reserve Transformers	2-7			
1. Cause can be either due to auto-protection circuit or operator error				
2. The expected sequence of events are as follows:	2-8			|1
a. loss of transformers				
b. recirc. condensate, booster and feedwater pump motors trip				
c. Rx scram-loss of power				
d. MSIV's close				
e. relief valves actuate, then close as necessary				
f. RCIC and HPCS initiate on low level				
3. Compare Fig. 2-H to events and explain parameter deviations		Fig.2-H	2.3	|1
J. Loss of all Grid Connections	2-9			
1. Caused by various conditions resulting in electrical grid instabilities				
2. The following sequence of events is expected:			2.4	|1
a. loss of electrical load				
b. TCV fast closure-turbine trip				
c. recirc. and circ. pumps trip due to loss of power				
d. Rx. scram-TCV position				
e. feedwater, condensate and booster pumps trip.				
f. TCV's closed				
g. TBV's regulate pressure				
h. relief valves groups 1-3 actuate				
i. MSIV closure initiated				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
j. remaining relief valves actuate				
k. relief valves cycle to regulate pressure				
K. Loss of Feedwater Flow	2-10			
1. Various failures and auto-signals may cause loss of feedwater flow				
2. The expected sequence of events are as follows:			2.4	|1
a. all feedwater pumps trip				
b. recirculation runback				
c. feedwater flow goes to zero				
d. rx scram on low level				
e. recirc. pump trip				
f. MSIV isolation initiates				
g. RCIC and HPCS initiate				
h. MSIV's fully closed				
i. relief valves cycle to regulate pressure				
3. Compare Fig. 2-K with the events to explain parameter deviations		Fig.2-K	2.3	|1
L. Failure of RHR S/D cooling	2-11			
1. Caused by the following:				
a. loop suction valve fails shut				
b. loss of another loop				
c. loss of offsite power				
d. SSE equipment only utilized				
e. operator involvement after 10 minutes				
2. The following events occur:			2.4	|1
a. plant S/D-loss of offsite				
b. loss of one D/G				
c. suppression pool cooling initiated				
d. controlled SRV depressurization started				

	Text Ref. Page	Text Ref. Fig.	S.L.O.
e. blowdown to 100 psig completed			
f. failure of RHR S/D cooling			
g. alternate S/D cooling initiated			
3. If S/D cooling is lost, another means of removing heat is established (alternate S/D cooling)			

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 3 TRANSIENT ANALYSIS

Given the reactor at 100% power, state the changes in the major plant parameters that would result from a decrease in reactor water temperature.

100-3.1 Describe the response of all three reactivity coefficients to a decrease in reactor water flow rate.

100-3.2 List the instrumentation provided in the Control Room that would be affected by a decrease in reactor water flow rate.

100-3.3 Provided the accident analysis graphs for the identified cause of decrease in reactor water flow rate, describe the reasons for the parameter deviations.

100-3.4 List the expected sequence of events for the various causes of a decrease in reactor water flow rate.

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
I. <u>INTRODUCTION</u>	3-1			
<u>Student Learning Objectives</u>				
A. A decrease in reactor water flow may result in overheating the clad				
II. <u>DISCUSSION</u>				
A. Trip of one Recirculation Pump				
1. A recirc. pump may trip due to any of the following conditions:				
a. rx low level (L2)				
b. TCV or TSV closure				
c. high pressure				
d. over-current protection				
e. suction valve not fully open				
f. operator error				
g. loss of electrical power				
h. initiation senor or equipment malfunctions				
2. The following events are expected:			3.4	|1
a. recirc. pump trips				
b. reverse flow in tripped loop				
c. high water level trips turbine and feed pumps				
d. normal initiation of recirc. pump trip				
e. rx scram - TSV position				
f. TBV's regulate				
g. relief valves actuate, then close				
h. RCIC and HPCS initiate on low level (L2)				
3. Compare Fig. 3-A with events to explain parameter deviations	3-2	Fig.3-A	3.3	|1
B. Trip of Two Recirculation Pumps				
1. The causes for this transient are similar to section A of this chapter				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
2. The following sequence of events is expected:	3-2		3.4	1
a. both recirc. pumps trip				
b. high rx water level trips turbine and feed pumps				
c. rx scram-TSV position				
d. TSV's closed, TBV's regulating				
e. relief valves actuating, then closing				
f. RCIC and HPCS initiate on low level (12)				
3. Compare Fig. 3-B with events to explain parameter deviations	3-3	Fig.3-B	3.3	1
C. Closure of One Recirculation Valve				
1. Caused by a loop controller failure resulting in a stroking rate of 60%/sec				
2. The following events result:			3.4	1
a. initiate fast closure of one recirculation valve				
b. valve at minimum flow position				
c. high rx water level trips turbine and feed pumps				
d. rx scram-TSV position				
e. TSV's closed, TBV's regulating				
f. relief valves actuating then closing				
g. RCIC and HPCS initiate on low level (L2)				
3. Compare Fig. 3-C to the events to explain parameter deviations	3-4	Fig.3-C	3.3	1
a. similar to trip of one recirculation pump				

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
D. Closure of Two Recirculation Valves	3-4			
1. Cause is similar to section C of this chapter				
2. The following events are expected:			3.4	|1
a. initiate fast closure of two recirculation valves				
b. high rx level trips turbine and feedwater pumps				
c. rx scram - TSV position				
d. TSV's closed, TBV's regulating				
e. both recirculation valves at minimum flow positions				
f. relief valves actuate and then close				
g. RCIC and HPCS initiate on low level (L2)				
3. Compare Fig. 3-D with the events to explain parameter deviations	3-5	Fig.3-D	3.3	|1
a. responses similar to two recirc. pumps tripping				
b. flow decrease slower than one valve closure due to limiter				
E. Recirculation Pump Seizure	3-5			
1. Caused by instantaneous stoppage of the pump motor shaft				
2. The sequence of events are as follows:			3.4	|1
a. single pump shaft seizure				
b. reverse flow in affected loop				
c. high rx level trips turbine and feedwater pumps				
d. rx scram - TSV position				
e. TSV's, TBV's regulate				
f. relief valves actuate, then close				
g. RCIC and HPCS initiate on low level (L2)				

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
3. Compare Fig. 3-E to events to explain parameter responses	3-6	Fig.3-E	3.3	|1

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 4 TRANSIENT ANALYSIS

Given the reactor at the worst case power level for each discussed reactivity and power distribution anomaly, state the changes in the major plant parameters that would result from each anomaly transient.

100-4.1 Describe the response of all three reactivity coefficients to each anomaly transient.

100-4.2 List the instrumentation provided in the Control Room that would be affected by a reactivity or power distribution anomaly.

100-4.3 Provided the accident analysis graphs for the identified anomaly describe the reasons for the deviations in the parameters.

100-4.4 List the expected sequence of events for the various causes of a reactivity or power distribution anomaly.

VI. LESSON CONTENT

	Text Ref. Page	Text Ref. Fig.	S.L.O.
I. INTRODUCTION	4-1		

Student Learning Objectives

A. Reactivity and power distribution anomalies are related to:

1. Control rod manipulations
2. Increases in core flow
   a. reduces voids
   b. increases neutron moderation
   c. increases reactor power

II. DISCUSSION

A. Control Rod Withdrawal Error During Refueling

1. Concern is inadvertant criticality
2. Transient is prevented by the following:
   a. procedural compliance
   b. rod blocks
   c. refueling platform interlocks
   d. control rod design

B. Continuous Rod Withdrawal During Reactor Startup (Text Ref. Page 4-1)

1. Not a credible transient
2. All of the following would have to occur:
   a. failure of RSCS
   b. failure of RWM
   c. selection of high worth rod
   d. rod selection contrary to procedures
   e. operator non-acknowledgement of alarms

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
C. Rod Withdrawal Error at Power	4-2			
1. Caused by operator-pulls-out-of-sequence, highest worth rod till rod block				
2. The following sequence of events results:			4.4	|1
a. rod is withdrawn				
b. total and local power rises				
c. operator ignores LPRM indications				
d. operator ignores RBM indications				
e. RBM inserts a rod block				
f. core stabilizes at higher power				
g. operator reinserts rod				
h. core stabilizes at rated conditions				
3. Overall results are insignificant				
D. Abnormal Startup of an Idle Recirculation Pump	4-2			
1. Caused by operator error				
2. The sequence of events are as follows:	4-3		4.4	|1
a. pump started				
b. jet pump flow goes positive				
c. pump at full speed				
d. last of cold water leaves drive loop				
e. peak value of core inlet subcooling				
f. peak thermal power				
g. steady-state reached				
3. Compare Fig. 4-D to events to explain parameter deviations		Fig.4-D	4.3	|1
a. neutron flux about 122% peak				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
E. Recirculation Flow Control Failure-Increasing Flow (one loop)	4-3			
1. Caused by failure of master or flux controller				
2. The following events result:	4-4		4.4	|1
a. loop controller failure				
b. rx scram-APRM high flux				
c. TCV's start to close				
d. TCV's closed				
e. feedwater cuts back due to rising level				
f. new steady-state				
3. Compare Fig. 4-E to the above events to explain parameters deviations		Fig.4-E	4.3	|1
a. flux peaks at 308%				
F. Recirculation Flow Control Failure-Increasing Flow (two loops)				
1. Cause similar to the cause in section E of this chapter				
2. The following sequence of events results:			4.4	|1
a. failure of master controller				
b. rx scram-APRM high flux				
c. TCV's start to close				
d. feedwater cuts back due to rising level				
e. TCV's closed				
f. new steady-state				
3. Compare sequence of events to Fig. 4-F to explain parameter deviations		Fig.4-F	4.3	|1
a. flux peaks at 241%				

VI. LESSON CONTENT

	Text Ref. Page	Text Ref. Fig.	S.L.O.
G. Misplaced Bundle Accident			
1. Caused by the following errors:			
a. bundle placed in the wrong location			
b. correct bundle placed in wrong place			
c. core verification misses errors			
d. plant brought to full power			
e. plant continues operation			
2. No significant problems result from this transient			
H. Control Rod Drop Accident	4-6		
1. Assume the following:			
a. 770 fuel rods fail			
b. activity reaching the condenser is composed of:			
1) 100% of the fuel noble gases			
2) 10% of fuel halogens			
c. activity from condenser leaks directly to environment at 1% per day			
2. Explain offsite exposures in text			

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 5 TRANSIENT ANALYSIS

Given the reactor at 100% power, state the changes in the major plant parameters that would result from an increase in reactor water inventory.

100-5.1 Describe the response of all three reactivity coefficients to an increase in reactor water inventory.

100-5.2 List the instrumentation provided in the Control Room that would be affected by increased inventory.

100-5.3 Provided the accident analysis graph for the identified cause of increased reactor water inventory describe the reasons for the parameter deviation.

100-5.4 List the expected sequence of events for an increase in reactor water inventory.

VI. LESSON CONTENT

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
I. INTRODUCTION				
Student Learning Objectives				
A. Carryover of water to the main turbine is the major concern				
II. DISCUSSION				
A. Inadvertant HPCS start	5-1			
1. Cause is operator error				
2. The following events result:			5.4	1
a. HPCS injection into vessel				
b. full flow established				
c. depressurization effect stabilized				
3. Compare Fig. 5-A with the events to explain parameter deviations		Fig.5-A	5.3	1
a. neutron power level only slightly above normal				

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 6 TRANSIENT ANALYSIS

Given the reactor at 100% power, state the changes in the major plant parameters that would result from an increase in reactor water inventory.

100-6.1 Describe the response of all three reactivity coefficients to a decrease in reactor water inventory.

100-6.2 List the instrumentation provided in the Control Room that would be affected by decrease in reactor water inventory.

100-6.3 Provided the accident analysis graphs for the identified cause of decreased reactor water inventory, describe the reasons for the parameter deviations.

100-6.4 List the expected sequence of events for a decrease in reactor water inventory.

VI. LESSON CONTENT

Text Ref. Page | Text Ref. Fig. | S.L.O.

I. <u>INTRODUCTION</u>

<u>Student Learning Objectives</u>

A. A decrease in inventory may result in overheated fuel

II. <u>DISCUSSION</u>

A. Instrument Line Break

1. Cause - a liquid or steam line break which is:
    a. outside primary containment
    b. within a controlled release structure
    c. instantaneous, circumferential break
    d. no isolatable
    e. not automatically or easily detected
2. The results of a leak are increases in secondary containment: |1
    a. radiation
    b. temperature
    c. humidity
    d. noise
3. Explain the calculated exposures in the text

B. Steam Pipe Break Outside Containment 6-2

1. Cause - a steam line breaks which is:
    a. the largest line
    b. instantaneously, circumferentially broken
    c. downstream of outboard MSIV

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
2. The following sequence of events occurs:			6.4	|1

   a. steam line breaks
   b. MSIV's start closing-high flow
   c. rx. scrams-MSIV position
   d. MSIV's fully closed
   e. RCIC and HPCS would initiate (neither is considered available)
   f. relief valves cycle
   g. rx. water level decreases
   h. ADS starts timing
   i. ADS initiates
   j. low pressure ECCS initiates
   k. core reflooded

3. Explain the calculated exposures in the text

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
C. LOCA Inside Primary Containment	6-3			

1. No identified cause
   a. coincident with a safe S/D earthquake

	Text Ref. Page	Text Ref. Fig.	S.L.O.	
2. The following events occur:			6.4	|1

   a. pipe break
   b. scram
   c. decreasing water level
   d. HPCS and RCIC initiate
   e. MSIV closure
   f. LPCS and LPCI initiate

3. Explain the calculated exposures in the text

	Text Ref. Page	Text Ref. Fig.	S.L.O.
D. Feedwater Line Break-Outside Containment	6-4		
1. No cause is identified			
2. The sequence of events is as follows:		6.4	1
a. feedwater line break			
b. check valves isolate rx.			
c. RCIC, HPCS, MSIV closure rx. scram and RPT initiate			
d. relief valves cycle to regulate pressure			
e. normal rx. cooldown established			
3. Less limiting than:			
a. steam line break outside containment			
b. feedwater line break inside containment			
c. DBA LOCA			

V. STUDENT LEARNING OBJECTIVES FOR CHAPTER 7 TRANSIENT ANALYSIS

For each of the radioactive releases discussed, provide a viable cause for that particular release.

100-7.1 State the transport method or expected flow path for each of the radioactive releases detailed.

100-7.2 Describe the system design feature or interlock that is provided to mitigate the severity of each of the radioactive releases.

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
I. INTRODUCTION	7-1			
Student Learning Objectives				
A. Postulated losses of system and/or component integrity resulting in possible radioactive release				
II. DISCUSSION				
A. Radioactive Gas Waste System Leak or Failure				
1. Possible causes				1
a. earthquake				
b. hydrogen explosion				
c. failure of spatially related equipment				
2. Seismic event only cause truly plausible				
a. due to design, must be more severe than design requirements				
3. The following sequence of events occurs:				
a. off-gas system fails				
b. noble gases are released				
c. ARMs alarm				
d. operator takes action				
1) appropriate isolations				
2) manual scram				
4. The transport path consists of:	7-2		7.1	1
a. from failed charcoal absorber				
b. to environment				
c. no credit taken for building ventilation system				
5. Explain calculated exposures in the text				

Lesson Content	Text Ref. Page	Text Ref. Fig.	S.L.O.	
B. Radwaste Release Due to Liquid Radwaste Equipment Failure	7-3			
1. Leaks from the Radwaste Building are unlikely due to a steel liner				
2. CSTs could leak due to				
a. tank failure				|1
b. operator error				
3. The leak pathway would be as follows:			7.1	|1
a. from the CST's				
b. into CST building				
c. to Lake Ontario				
C. Fuel Handling Accident	7-4			
1. Most severe is dropping a fuel assembly on top of the core				
a. caused by failure of the fuel assembly lifting mechanism				|1
2. The following sequence of events occur:				
a. fuel assembly drops on top of core				
b. fuel rods are damaged, gaseous fission products released				
c. rad monitoring alarms, ventilation isolates, SGTs starts				
d. operator action begins				
3. Assumed that 125 total rods fail				
4. The transport pathway is as follows:			7.1	|1
a. from the fuel pool				
b. to the rx. building atmosphere				
c. to the environment through SGTS				
5. All the noble gases and 1% of the halogens in the pool become airborne				

VI. LESSON CONTENT	Text Ref. Page	Text Ref. Fig.	S.L.O.	
6. Explain cumulative environmental releases in the text				
D. Spent Fuel Cask Drop Accident	7-2			
1. This accident is not a credible event				
a. analysis has been performed				
2. The following assumptions are made:				
a. fuel has been out of the reactor for at least 90 days				
b. cask falls 92 ft. onto the rail car				
c. some coolant leaks from the cask				
3. The transport path is as follows:			7.1	|1
a. from the cask				
b. to the rx. bldg. atmosphere				
c. to the radwaste/rx. bldg.-vent				
d. to the environment				
4. Explain the activity releases calculated in the text				