NOTES & REFERENCES

Module 233-0

INTRODUCTION TO THE COURSE

AUDIENCE AND PREREQUISITES

The course is for Authorized Nuclear Operators in Training (ANOIT's) and Shift Supervisors in Training (SSIT's) taking the nuclear general part of their authorization training.

The prerequisites include:

1) All NGD generic training courses of level 4 and 3 (for ANOIT's) or PI (for SSIT's), as required by the initial and progression training programs.

2. Concepts from the following NGD generic training courses of level 2, which are a part of the general authorization training, will be used throughout this course:

    223 - Fluid Mechanics,
    224 - Chemistry,
    225 - Heat and Thermodynamics,
    227 - Nuclear Theory,
    228 - Materials Science.

This course builds on the information presented in all the courses mentioned above. This applies particularly to the reactor and auxiliaries (R&A) course(s) which you have taken during your initial and progression training: the 433 and PI33 course. To avoid unnecessary repetition, many references are made in this course to the information covered in the prerequisite R&A course(s). For simplicity, these two courses are referred to in this course as 'previous R&A courses'. It is important that you review these courses thoroughly. Remember that some test questions that you will be asked during this course may be based on the objectives of the previous R&A courses.

NOTES & REFERENCES

COURSE CONTENTS

This course covers a large part of any CANDU plant, namely **the reactor and auxiliary equipment that makes up the "nuclear" side of the unit**. A list of the major topics covered by the course is provided in the table of contents at the beginning of the course notes.

While the previous R&A courses give basic description of this equipment and its normal operation, this course concentrates more on startups, power manoeuvres, shutdowns, operational problems, upsets and incidents.

Good understanding and thorough technical knowledge of these operational aspects by you - a future shift supervisor or first operator - is crucial to ensure safe, reliable and efficient operation of this multi-million dollar equipment that one day you will be entrusted with. This course will help you achieve this by providing you with relevant technical information. For example, you will learn about major upsets and problems, their potential adverse consequences, and major corrective and protective actions to mitigate these consequences. Discussion of these general operational concerns and procedures in this course will prepare you for the station specific part of the authorization training during which you will learn specific indications, alarms, annunciations, actions and procedures.

Being part of the general phase of the authorization training, this course does not favour any particular CANDU station. Only the most typical equipment and operating practices - that apply to most stations - are discussed. Coverage of numerous station specific differences is not the intent of the course, as it would be impractical and confusing. A natural consequence of this approach is that some information presented in this course may not apply to your station. These instances, however, are not frequent. In the few cases where different terminology is used at different stations when referring to essentially the same equipment, the most typical name is used in the course.

COURSE STRUCTURE

The course is made up of 19 self-contained units of instruction called "modules" that are listed in the table of contents at the beginning of the course notes. Except for this module, all the remaining 18 modules are made up of three major parts:

1. Objectives.

The objectives are placed up front of each module. They serve two purposes. First, they **specify the contents** of the module so when you read them, you will get a pretty good idea of what you will learn from

NOTES & REFERENCES

the module. Second, they **define the scope of the test** that you will be subjected to **under closed-book conditions** to demonstrate that you have attained the required knowledge by meeting or exceeding the pass mark.

It is important that **after having finished each module you review its objectives** to make sure that you can meet their requirements. To help you find the instructional text which addresses each objective, the pages where this text is located are specified in the outer margin right beside each objective (as indicated to the right of this paragraph).

⇔ *Pages 6-7*

It is worth emphasizing that these objectives have been cross-referenced to detailed analysis of the jobs and tasks performed by the first operator. They have also been reviewed by a panel of authorized first operators, shift operating supervisors and shift supervisors to ensure that they **are relevant to your future job**.

2. Instructional text.

The instructional text is placed right after the objectives and contains all the information that you will need to learn in order to meet them. The text is **cross-referenced to the objectives**. You can easily find these references in the outer margin (as indicated to the right of this paragraph). They indicate the beginning of the text which covers the specified objective.

⇔ *Obj. 0.1 c)*

In the instructional text, **new terms and key concepts are highlighted** to stand out from the rest of the text and thus attract your attention. They are again **reinforced in summaries** throughout the module (except during short modules, where only one summary is present at the end).

Occasionally, the instructional text is supplemented with a **sidenote**. Sidenotes are placed in the outer margin, and the text they refer to is marked with an asterisk (*). Typically, sidenotes specify references to other sections of the same module, other modules or other courses. This will help you integrate individual modules and courses in one logical set. Other sidenotes provide supporting information, like the typical value of the operating parameter being discussed in the instructional text. The purpose is to help you understand the main concepts or emphasize their importance. You are **not required to remember** any information included in the sidenotes.

* This is a sample of a sidenote.

3. Assignment

The assignment is placed at the module end and consists of several questions that address the objectives. The purpose of the assignment is to give you an opportunity to practice the acquired knowledge and to check for yourself how well you understand and remember the

NOTES & REFERENCES

presented material. To find out how much you remember, it is important that you **not** refer to the instructional text when you are working on the assignment. Therefore, if you don't feel confident about your knowledge of the subject matter, it is better to study it again or discuss your doubts with the instructor or your classmates rather than to do the assignment prematurely.

In most cases, to answer the assignment questions you will need to **fill in the blanks and choose the right statement(s)** from those listed in brackets. In the few other cases, the instructions provided explain what you are expected to do. This built in practice may or may not be similar in style to the test questions that you will be required to do.

Except for short modules, you do not have to wait until you finish the whole module in order to work on the assignment. Typically, you can do this right after those summaries of the key concepts where instructions are placed that guide you to specific assignment questions.

No answers are provided to the assignment questions. This is because all the information that you will need to answer them is given twice: first, it is presented in the instructional text and second, it is condensed in the summaries of the key concepts. Thus, you should be able to check your answer easily by referring to the relevant parts of the instructional text and summaries. In case of doubts, consult the instructor or your classmates.

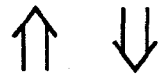
Because all the assignment questions are combined at the module end. You can **easily separate them** from the rest of the module if the instructor wants to mark them or if you want to submit them for instructor's evaluation.

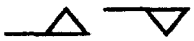
TERMINOLOGY AND SYMBOLS

In case you have doubts about the exact meaning of some terms used in this course, a glossary is given on the next two pages. While the explanations are also valid for other courses, the examples used are specific to this course.

In this glossary, **nouns** of similar meaning are defined one after another so that you can easily see their similarities and differences. The **action verbs** (mainly used in the course objectives and tests) are sorted by the required volume and complexity of the expected answer - starting with the easiest and ending with the most demanding ones.

In the instructional text, many diagrams illustrate major automatic responses to a particular operational event or parameter, eg. HTS pressure error. In these diagrams, the following **symbols** are used:

 = Gradual response (eg. of a level controller) whose magnitude increases when the initiating parameter increases or decreases, respectively;

 = On-off response (eg. of a level switch) which occurs at a particular value of the initiating parameter when it is rising or dropping, respectively. The 'arrow' side of the symbol indicates the 'on' or 'action' side.

GLOSSARY OF TERMS USED IN THE 233 COURSE

A) NOUNS

TERM	*EXPLANATION*	*EXAMPLE*
Actions	Activities which result in a changed state of a device or a parameter. Can be automatic or performed by the operator.	Start up a pump.
Corrective actions	Actions performed to restore the normal status of a device or to return a controlled parameter to its normal range.	Open a control valve.
Protective actions	Actions performed to protect equipment integrity and personnel safety.	Trip the reactor.
Precautions	Actions taken or to be avoided to prevent some adverse consequences.	Purge moderator cover gas without lowering cover gas pressure to avoid D_2 excursions.
General operating practices	General (not detailed or station specific) actions taken to reach a certain operational goal, eg. to ensure safe operation.	Reduce reactor power to within the capacity of the available heat sink.
Adverse consequences	Undesirable outcome of an event, action(s) or lack of action(s). Consequences can be immediate or long-term effects on unit equipment, operational status or safety.	Structural damage due to excessive ΔT between the end shield and the calandria.
Operating concerns	Concern over a given situation as to its possible adverse consequences.	An explosive D_2 & O_2 mixture being formed in the moderator cover gas.
Upset	Disturbance of the normal status of the equipment.	Reactor stepback.

NOTES & REFERENCES

Abnormal incident	Major upset that seriously jeopardizes equipment integrity and personnel safety.	LOCA, main steam pipeline rupture.
Indications	Any source of information about the equipment status.	Control room or field indicators, alarms,equipment noise.

B) ACTION VERBS

TERM	*EXPLANATION*	*EXAMPLE*
List	To provide a series of items. No further comment on the listed items is required.	List five factors which contribute to fuel failure.
Define	To give (in as few words as possible) the meaning of.	Define direct pressure relief.
State	To set forth. Used when a short response not requiring extensive detail is desired.	State the reasons for limiting power extracted from a fuel bundle.
Describe	To give a detailed account of. Usually used to ask for details of a device, system, principle of operation,etc.	Describe two general techniques for detecting and locating failed fuel in a reactor .
Explain	To give the reason(s) or cause(s) of, to make clear.	Explain how thermosyphoning is achieved in CANDU reactors.

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