Minor Program Adjustment

Faculty: ESNS	**Date**: 2017-11-15
Program: Graduate Diploma – Operations and Maintenance	
Undergraduate: ☐	**Graduate**: X

Minor Program Adjustments include: New required courses, Deletion of required courses, Other changes to degree requirements or program learning outcomes, New academic requirements or changes to existing requirements.

Motion to CPRC or GSC:

Proposal Brief

Summary of the proposed change (for pathways, please include details on the specific or unspecified transfer credits students will receive, if applicable)

Delete NUCL 4360 Nuclear Plant Electric and Auxiliary Systems
Add NUCL 5160G CANDU Electric and Auxiliary Systems (new course)
Add NUCL 5111G CANDU Safety Systems (new course)
Add NUCL 5140G CANDU Steam Supply Systems.

Description of the ways in which the proposed change will enhance the program and/or opportunities for students

NUCL 4360 Nuclear Plant Electric and Auxiliary Systems is part of the BASc program in Nuclear Power which is not currently accepting applicants and hence the course is not currently offered. Its subject matter is covered, at a more advanced level, in the newly-introduced graduate course, NUCL 5160G CANDU Electric and Auxiliary Systems

NUCL 5111G CANDU Safety Systems, and NUCL 5140G CANDU Steam Supply Systems are very appropriate for the graduate diploma in Operations and Maintenance as they will enhance students' familiarity with these nuclear-power plant systems.

Process of consultation with other units if the change(s) involves students, staff, and/or faculty from other programs or courses
N/A
Analysis of financial and enrolment implications
No additional resources are required.
Proposed Implementation Date (state term, e.g. Fall 2017)
Fall 2018
Transition Plan (include a plan for all current students in the program, by year level)
N/A

Calendar Copy and/or Program Maps (highlight revisions to existing curriculum)

Attachments: New course templates for NUCL 5110G and NUCL 5160G

APPROVAL DATES

Curriculum Committee approval	September 9, 2017
Faculty Council approval	September 28, 2017
GSC Approval	January 30, 2018
Submission to Academic Council	

NEW COURSE TEMPLATE

Faculty: Energy Systems and Nuclear Science		
Course title: CANDU Electric and Auxiliary Systems		
Course number: NUCL 5160G	**Cross-listings:**	**____ Core __✓__ Elective**
Credit weight: 3	**Contact hours:** 3 Lecture, 0 Lab, 0 Tutorial, 0 Other	

CALENDAR DESCRIPTION

This course will cover nuclear plant unit electrical distribution systems, plant emergency electric power systems; water and air cooling systems; low-pressure, high-pressure and recirculating service water systems; demineralized water systems; heavy water management and upgrading; instrument and breathing air systems. The design and operating principles of nuclear plant electric and auxiliary systems are studied with reference to CANDU nuclear-electric units in the following areas: Classes of Power; Class 4, 3, 2 and 1 Power, Standby Generators, Emergency Power; Low Pressure Service Water, Powerhouse Upper Level Service Water, Recirculating Cooling Water, Emergency Service Water, Auxiliary Service Water, Instrument Air, Breathing Air, Service Air. Problems and/or projects make use of CANDU plant simulators that demonstrate, and provide opportunities for students to analyze, plant design and operating experience, so as to enhance and verify graduate-level learning outcomes.

Prerequisites	**None**
Co-requisites	**None**
Credit restrictions	**None**
Credit exemptions	**None**

LEARNING OUTCOMES

Students who successfully complete the course have reliably demonstrated the ability to:

1: explain the key design considerations and critique how these are applied to the operation of a typical nuclear plant electric distribution system.

2: explain and evaluate the use of emergency electric power systems in CANDU power plants.

3: evaluate the application of key design considerations in the operation of the water and air cooling systems as encountered in CANDU power plants.

4: identify and select the appropriate design and operating envelopes for low-pressure, high-pressure, demineralized, and recirculating service systems.

5: evaluate the role and operating characteristics of heavy water management and upgrading as used in CANDU power plants.

6: explain the key design considerations and critique how these are applied to the operation of a typical instrument and breathing air system in a CANDU power plant.

7: with reference to a CANDU unit, verify the adequacy of the key design and operating features of the different classes of electric power.

8: demonstrate the ability to independently and/or in small groups analyze and diagnose problems encountered in the design, commissioning and/or operation of the electric and auxiliary systems of a nuclear unit, and to propose engineered solutions.

DELIVERY MODE

This one semester course will be delivered via three hours of classroom lectures per week, in a classroom that is equipped to demonstrate nuclear plant electric and auxiliary system design features and operation using computer simulations of nuclear power plants.

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of nuclear power plant simulators that replicate the design and operation of the key hardware and software that comprise the electric and auxiliary systems studied. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including in-class discussions and quizzes, mid-term and final exam, written assignments involving problems and/or projects that reflect plant design and operating experience and require independent and/or small group analysis to diagnose problems and to propose engineered solutions.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

Course reflects material provided by and adapted in consultation with industry stakeholders. Simulation software supplied by industry stakeholder. No additional financial resources are required to deliver this course.

APPROVAL DATES

Date of submission	***August 24, 2017***
Curriculum Committee approval	***September 9, 2017***
Faculty Council approval	***September 28, 2017***

NEW COURSE TEMPLATE

Faculty: Energy Systems and Nuclear Science		
Course title: CANDU Safety Systems		
Course number: NUCL 5111G	**Cross-listings:**	**____ Core __✓__ Elective**
Credit weight: 3	**Contact hours:** 3 Lecture, 0 Lab, 0 Tutorial, 0 Other	

CALENDAR DESCRIPTION

This course will cover the safe operation of nuclear power plants as applied to: worker and public safety requirements; sources of radioactive release; defense in depth; principle of control, cool, contain; operational safety envelope; maintenance and testing requirements for safety systems; accident prevention, mitigation and accommodation; separation and independence; redundancy; common mode events; inherent safety features; plant safety systems; safety culture, management of plant safety; design basis accident; accident analysis; examples of unit accidents. The design and operating principles of nuclear plant safety are illustrated with reference to the following CANDU systems: Shutdown Systems 1 and 2, Emergency Coolant Injection System, Negative Pressure Containment System, Group 1 and Group 2 System concept and applications, Instrument Air System, Emergency Power and Water Systems, including the Steam Generator Emergency Cooling System and the Post-Accident Water Cooling System. Problems and/or projects make use of CANDU plant simulators that demonstrate, and provide opportunities for students to analyze, the interdependence and dynamic responses of process and safety systems to enhance and verify graduate-level learning outcomes.

Prerequisites	**None**
Co-requisites	**None**
Credit restrictions	**None**
Credit exemptions	**None**

LEARNING OUTCOMES

Students who successfully complete the course have reliably demonstrated the ability to:

1: explain and apply Reactor Safety Concepts as applied to the operation of CANDU power plants.

2: explain and apply Fuel Cooling and Heat Transfer Phenomenon.

3: explain the application of the terms: Two Group Philosophy, Safety Analysis Derived Acceptance Criteria, Design Basis, Applicable Laws, Codes and Standards, as encountered in nuclear power plants.

4: evaluate the application of design and operating principles to Shutdown Systems 1 and 2, the Emergency Coolant Injection System, and the Negative Pressure Containment System as used in CANDU plants.

5: critique the application of the design and operating principles of such CANDU safety support systems as the Emergency Water Systems and Emergency Power Systems.

6: evaluate the causes, symptoms, design and operational requirements for such Abnormal Incidents as Loss of Coolant; Loss of Regulation; Loss of Flow; Loss of Class 4, as applied to CANDU units, and identify improvements where applicable.

7: with reference to a CANDU unit, verify the adequacy of the design and operating practices as these apply to Risk / PRA / Beyond Design Events.

8: demonstrate the ability to independently and/or in small groups analyze and diagnose problems encountered in the design, commissioning and/or operation of the safety systems of a nuclear unit, and to propose engineered solutions.

DELIVERY MODE

This one semester course will be delivered via three hours of classroom lectures per week, in a classroom that is equipped to demonstrate the key design features and operation of nuclear plant safety systems using computer simulations of CANDU plants.

TEACHING AND ASSESSMENT METHODS

The teaching and learning of the course content will be supported with the use of nuclear power plant simulators that replicate the design and operation of the key hardware and software that comprise the safety systems studied. A wide range of techniques will be used to enhance and verify that the learning outcomes have been achieved, including in-class discussions and quizzes, mid-term and final exam, written assignments involving problems and/or projects that reflect plant design and operating experience and require independent and/or small group analysis to diagnose problems and to propose engineered solutions.

CONSULTATION AND FINANCIAL IMPLICATIONS, WHERE APPROPRIATE

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