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Feedback Report of the Pilot Training Session in French

ADVANCED RECOMMISSIONING (RCX) COURSE – 3RD EDITION
3.5 DAYS – PILOT TRAINING SESSION FROM MARCH 15 TO 18, 2011 – VARENNES, QUEBEC, CANADA

Organized by:
CANMETENERGY
OFFICE OF ENERGY EFFICIENCY (OEE)



Lecture course and group work

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BACKGROUND

CanmetENERGY is implementing a national continuous building optimization training program that includes awareness, training and demonstration initiatives. In parallel, Portland Energy Conservation Inc. (PECI) developed a course that meets the training needs of CanmetENERGY's new program.

PECI is a driving force in the recommissioning (RCx) industry and has been involved in almost every major RCx program in the USA. PEGI has developed and implemented RCx programs across the USA, and has provided commissioning (Cx) services to private and public building owners.

In this context, CanmetENERGY, in collaboration with the Office of Energy Efficiency (OEE), contracted PEGI to hold four pilot training sessions in English in Canada. During these pilot sessions, the Canadian experts confirmed the relevance of the course and provided the necessary information to adapt it to the Canadian context^{1,2}. Following this adaptation, CanmetENERGY translated the learning material and organized several pilot training sessions in French, the most recent of which was held March 15 to 18, 2011 at the CanmetENERGY building located in Varennes (Quebec, Canada). This report presents a brief overview of the most recent French pilot session, summarizes the participants' main comments and proposes recommendations to improve the course.

COURSE DESCRIPTION

The curriculum and agenda of the training session (French version) titled "*Advanced Recommissioning (RCx) Course*" are provided in Appendix A.

TRAINERS

Michel Parent, Eng., M.Sc.A.

Michel Parent studied engineering at Université Laval. He then obtained his master's degree in mechanical engineering, with a specialization in heat transfer and thermodynamics, from the University of Waterloo.

He was in charge of the Laboratoire d'énergie solaire [solar energy laboratory] at the Institut national de la recherche scientifique [national institute of scientific research] (INRS). He then joined the Centre de recherche industrielle du Québec [Quebec centre for industrial research] (CRIQ) as an R&D engineer for the energy group.

In 1996, he founded TECHNOSIM Consulting Group, a firm specializing in energy auditing, recommissioning and building energy simulations.

Over the past 20 years, he has performed more than 150 energy audits and recommissioning projects for businesses and institutions across North America. He has been in charge of a number of LEED and CBIP modelling projects. He was also in charge of developing the EE Wizard for Arenas modelling tool for Natural Resources Canada.

He was a technical editor in the field of energy simulation for LEED and other programs.

¹ A. Monarque et al. "**Feedback on the first pilot training session developed by Portland Energy Conservation Inc. (PECI)**," NRCan, CanmetENERGY, January 2007, 72 pp.

² A. Monarque et al. "**Feedback on the second pilot training session developed by Portland Energy Conservation Inc. (PECI)**," NRCan, CanmetENERGY, March 2008, 68 pp.

He is an expert trainer for the Office of Energy Efficiency (OEE), to which he provides training on the EE4 and EE Wizard modelling tools, and for Natural Resources Canada, where he teaches the Advanced Recommissioning Course.

Michel Parent is a well-known expert in the field of energy conservation in buildings and, more specifically, in auditing, recommissioning, modelling and simulation.

Guy Turgeon, Eng. M.Sc.A.

Guy Turgeon has a bachelor's degree in engineering and a master's degree in mechanical engineering from Université Laval. He has over 36 years' experience in engineering.

His résumé includes many projects in the public, commercial, industrial, institutional and residential sectors.

He has managed several multidisciplinary engineering teams within his own business and at several large engineering consulting companies.

He has given several lectures and written expert's reports on energy in buildings, energy efficiency, simulation, electrical efficiency, energy analysis, smart buildings, solar energy and geothermics.

He taught heating, ventilation and air conditioning at Université Laval and for ASHRAE in Québec. He is also a trainer for recommissioning (RCx) and energy efficiency programs.

Mr. Turgeon is known as a buildings and energy specialist, particularly regarding heat transfer, energy recovery and new technologies.

TARGET CLIENTELE

The overall target clientele for this training was those people involved in commissioning or recommissioning projects for commercial and institutional buildings in Canada. They are, in general, experienced people who hold technical positions, such as experienced engineers with expertise in HVAC systems and building operations. Their main skills are delivering energy efficiency services and implementing system ecoenergy improvements. Although they may already be qualified in RCx, they can benefit from the structured approach offered in NRCan's advanced course.

The clientele that participated in the pilot training session from March 15 to 18, 2011 was made up of engineers, mostly representing engineering consulting firms that offer specialized building systems services. The training helped them learn more about recommissioning. This training also provided an opportunity to receive comments from participants on course updates, including the addition of an exam. These comments are summarized in the Course Evaluation section.

PARTICIPANTS

Selection process for pilot session participants

CanmetENERGY drew up a list of potential participants based on a waiting list of people who expressed interest in taking the Advanced Recommissioning (RCx) Course and on its knowledge of engineering firms that offer building systems consultation services. Following invitations, participants were selected based on their résumés (on a first-come, first-served basis) and it was ensured that a wide range of consulting firms were represented. A total of 18 participants were selected to attend and provide feedback on the pilot training session.

Pilot session logistics

The logistics of the pilot session were handled by CanmetENERGY. The training was held in the CanmetENERGY Research Centre in Varennes, Quebec. Participants did not have to pay to attend but had to bring their own laptops. Meals were catered and the cost was covered by participants; CanmetENERGY was responsible for coordination between participants and the caterer.

List of participants

Olivier Allard	IFCS
Ian Ball	GES Technologies Inc.
Aboubakeur Bensikhelifa	Dessau
Nathalie Boudreault	SNC-Lavalin
André Deneault	BPR Building
Xavier Dion Ouellet	Roche Ltd.
Jean-Emmanuel Dufour Gravel	TST Energy Systems Inc.
Luc Dumas	INGEMA Consultants Inc.
Yan Ferron	Pageau Morel Inc.
Robert Gagnier	SNC-Lavalin
Geneviève Gauthier	Econoler
Philippe Giroux	Therméca
François Lachance	BBA Inc.
Gabriel Montminy	Roche Ltd.
Mathieu Richard	Bouthillette Parizeau
Alain St-Amand	GENIVAR
Enrico Tanguay	Pageau Morel Inc.
Marianne Vajstedt	GeniMac Inc.

Attendance

It is important to note that all participants attended the four days of training and took the exam.



Participants at the RCx training session held March 15-18, 2011

TOOLS USED

Materials provided to participants

The following documents were provided to each participant:

- The Course Notebook – Advanced RCx Course – 3rd edition – March 15, 2011 pilot version (486 pages). This notebook contains colour copies of the overheads presented in the course.
- The Examples and Exercises Book – Advanced RCx Course – 3rd edition – March 15, 2011 pilot version (167 pages). This book contains the examples and exercises used in the training.
- A course evaluation form (11 pages). This form was used to evaluate each course module and provide an overall course evaluation.
- Exam instructions (1 page). This document had to be signed by the participant and included in the envelope with the exam.
- Exam booklet (31 pages). This document is a booklet with all the exam questions and space in which to write the answers.
- Exam evaluation form (1 page).

Materials not provided to participants

The following documents are kept in a secure location and can be accessed only by certain people:

- Booklets used during the exam
- Bank of exam questions
- Answers to the exam questions

Materials provided by participants

Each participant had to bring a laptop.

COURSE EVALUATION

All participants completed a training evaluation form at the end of each module and an overall evaluation form at the end of the course (see Appendix B).

Below is a summary of participants' comments, for which the following rating scale was used:

Excellent: 6

Good: 4 to 5.9

Average: 2 to 3.9

Poor: 0 to 1.9

- Module 0: Course overview

This module was given a quality rating of 4.2, i.e., good. The points raised the most were:

- Several people enjoyed the participant introductions.
- Many participants would have liked to see a more detailed training plan and Table of Contents.

- Module 1: Introduction to RCx

This module was given a quality rating of 4.8, i.e., very good. The points raised the most were:

- Good introduction.
- Good energy and interaction between the participants and the presenters.
- The energy bill analysis and the consumption curves are difficult to follow.

- Module 2a: Phase 1: Planning – Part 1: Pre-screening

This module was given a quality rating of 4, i.e., good. The points raised the most were:

- The module contains a lot of information.
- Include only the pre-screening information.

- Module 2b: Phase 1: Planning – Part 2: Scoping

This module was given a quality rating of 3.6, i.e., average. The points raised the most were:

- It would be helpful to add a sample RCx plan.
- Review the example, reduce the scope and detail, include a less complicated example.

- Module 3a: Phase 2: Investigation

This module was given a quality rating of 4.7, i.e., very good. The point raised the most was:

- Incorporate examples of functional tests into the presentation.

- Phase 3b: Phase 2: Investigation – Power plants and pumping

This module was given a quality rating of 3.5, i.e., average. The point raised the most was:

- Review the exercise; it's too long and doesn't leave sufficient time for the analysis.

- Module 3c: Phase 2: Investigation – Ventilation systems

This module was given a quality rating of 3.4, i.e., average. The points raised the most were:

- This module covers a lot of material.
- Provide the Excel files or the formulas with the exercises.
- Exercises are too hard because there's no tool for calculating.
- Do a single case study as an exercise.

- Module 3d: Phase 2: Investigation – Measurement and control systems

This module was given a quality rating of 3.4, i.e., average. The points raised the most were:

- Focus on the formulas and hypotheses, rather than the calculations.
- Focus on the steps, not just the calculations.
- Good interaction between the participants and the presenters.

- Module 3e: Phase 2: Investigation – Findings log and investigation report

This module was given a quality rating of 3.8, i.e., average. The points raised the most were:

- Add a sample report.
- Good presentation.

- Module 4: Phase 3: Implementation

This module was given a quality rating of 3.4, i.e., average. The point raised the most was:

- This module was covered very quickly; some liked it, others didn't.

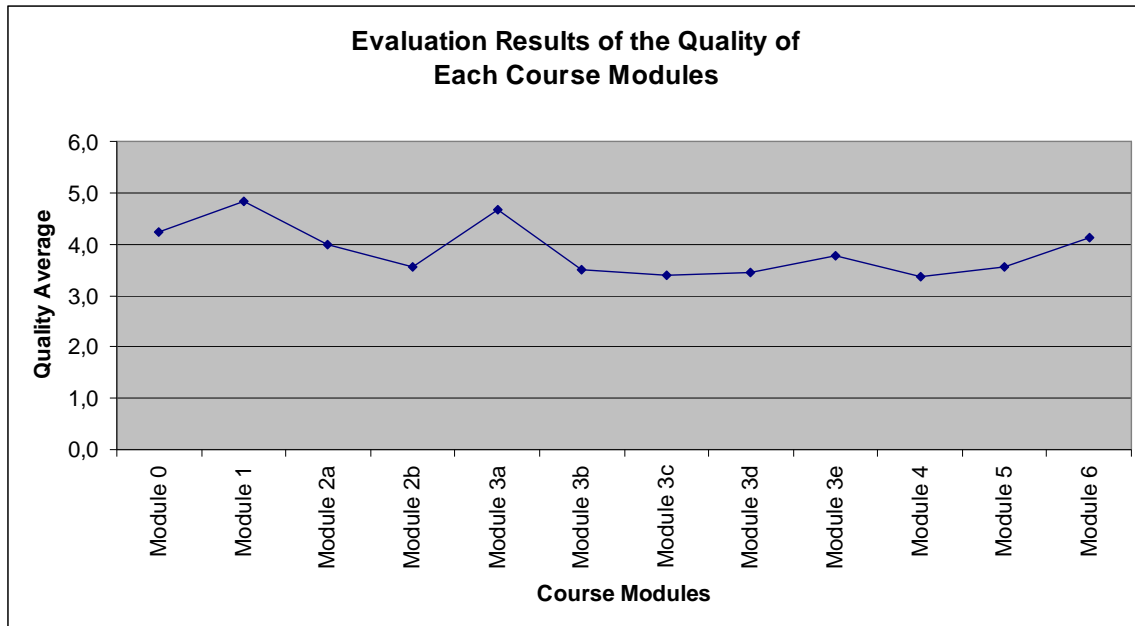
- Module 5: Phase 4: Hand-off and persistence

This module was given a quality rating of 3.6, i.e., average. The points raised the most were:

- Develop an IPMVP module based on this.
 - Separate hand-off and persistence.

 - Module 6: Conclusion
- This module was given a quality rating of 4.1, i.e., good. The points raised the most were:
- Good conclusion.
 - Review key points.

The graph below shows the quality of each module of the course:



The overall quality of the training was rated from poor (by only one person) to excellent at 68% (question 2) and the course content met participants' expectations at 76% (question 3). The overall level of satisfaction with this French session was 84%. Nearly all participants (94%) said that they would recommend this training to someone else (question 4). It should be noted that one person did not answer this question, which lowered the percentage from 100% to 94%.

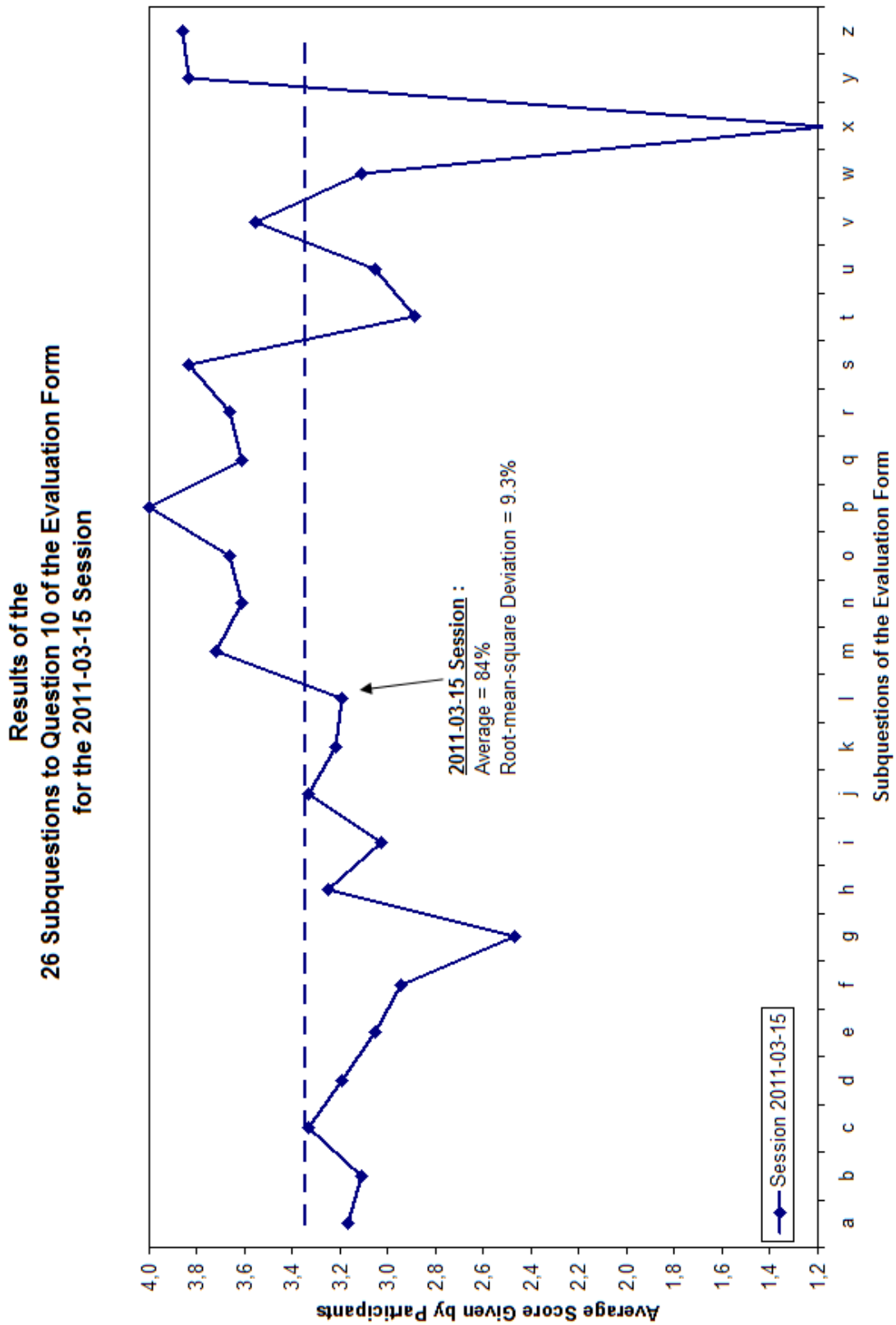
	French
	Varenes, QC 2011-03-15
	18 participants
Question 2: How would you rate the overall quality of the training?	68%
Question 3: Did the training meet your overall expectations?	76%
Question 4: Would you recommend this training to someone else?	94%
Question 10: Overall satisfaction	84%

Table 1 – Overall Rating

Note: The number of participants excludes trainers and NRCan staff involved in the delivery of the Advanced RCx Course.

The following graph outlines the results of the 26 subquestions to question 10 for the pilot session held March 15 to 18, 2011. This graph indicates that the standard deviation between participants' comments was high.

It is important to note that subquestion x (see the results table on page 12 and the questionnaire on page 34) was removed because it did not apply to the most recent training session, hence the point on the graph that is dropping toward 0.



The following table presents the subquestions to question 10 with the highest scores and the lowest scores. The highest scores were attributed to the trainers (subquestion p) and the room (subquestion z). The relatively lower scores were related to the time allotted for hands-on

exercises (subquestion g) and the amount of information provided to participants (subquestion t). Several participants commented on the exercises and course content. For example, they said that the exercises should be more of a focus and that the course notebook should be simplified, which corroborates the above-mentioned results. The participants' comments are presented in detail in Appendix D.

Subquestion with the <u>highest</u> score	Subquestion with the <u>lowest</u> score
p) Trainer knowledge of the topic was sufficient (100%)	g) The in-depth information and hands-on exercises provided have improved my ability to implement recommissioning projects (62%)
Subquestions with the <u>2nd highest</u> score	Subquestions with the <u>2nd lowest</u> score
z) The training room size and general accommodations were adequate (97%)	t) The amount of information provided was adequate (72%)

A few comments were made about the overheads. A few participants found that the overheads contained too much information and suggested replacing sentences with points.

There were a lot of comments on the practical exercises. The most common ones were to give more concrete examples, to provide detailed calculations and all the formulas and theorems that could be useful to participants, and to give more context in the exercises.

Lastly, a large proportion of participants commented that the training helped to foster a structured approach for completing RCx projects. Many participants also made positive comments: comments of satisfaction, congratulations to the CanmetENERGY team and the trainers, dynamism, etc.

PILOT EXAM

At the very end of the training, all participants took a pilot exam. It was an open-book exam consisting of 16 questions: three multiple-choice questions, nine essay questions and four calculations. The questions were chosen from a bank of 24 questions by the trainers.

The duration of the exam was 2 hours and 15 minutes (12:45 p.m. to 3:00 p.m. on Friday, March 18, 2011), including time taken to explain the instructions.

Each participant was given a personalized envelope containing the instructions (see Appendix D) and the exam booklet. The trainers were on hand for the duration of the exam to supervise and provide assistance as needed. All the documents were collected at the end of the exam.

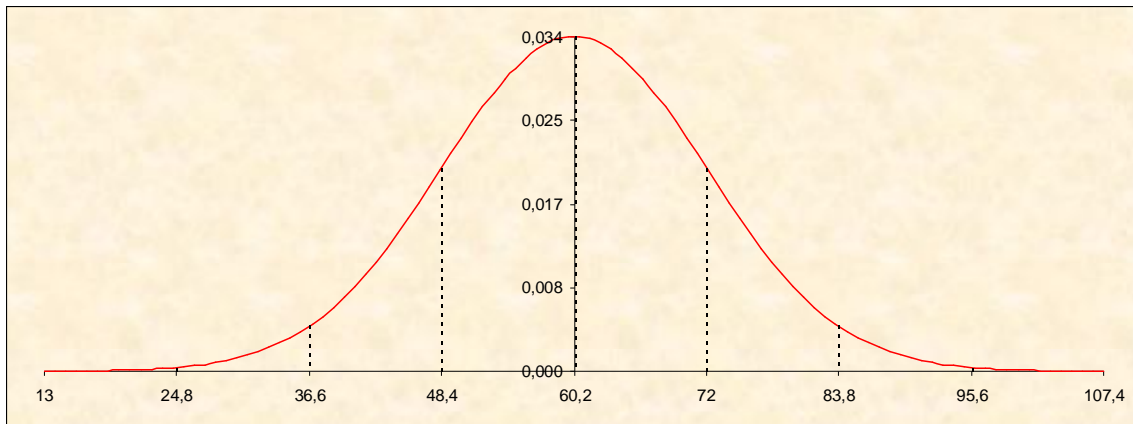
All of the exams were corrected by the same person using an answer key containing the keywords to look for in the answers and the detailed calculations. The exams were corrected anonymously one question at a time, i.e., all the question 1s were corrected, followed by all the question 2s, and so on. The corrections were validated by Guy Turgeon.

We had to adjust the marks because the questions that required calculations were not as well done and were worth more points. We think that participants did not do as well on this section because they did not have sufficient time. In future training sessions, the number of questions will have to be reduced to keep the exam to two hours. In this case, the weighting was changed to give the essay questions more weight.

The Gauss curve below shows the results of the exam.

Normal Distribution

Average	60,2
Root-mean-square Deviation	11,8



Participants did well overall. The pass mark was 45%. The average mark for the exam was 60.2% and the standard deviation was 11.8%.

The following are the exam question results in more detail:

- Original marking scheme:

	#1	#9	#12	#2	#3	#6	#8	#10	#11	#14	#15	#4	#5	#7	#13	#16	Exam total
	Time required by Mr. Turgeon (minutes)	2	1	3	7	7	1	1	5	4	5	2	5	25	20	20	
Weighting	/3	/2	/2	/5	/6	/2	/2	/6	/5	/6	/4	/9	/15	/15	/10	/8	Average
RESULTS	3	2	2	5	6	2	2	4	5	0	4	9	2.5	0	5	0	51.5
	3	2	2	5	6	2	0	1	5	0	4	4.5	5	0	0	3.5	43
	3	2	2	5	6	2	2	6	5	0	0	9	0	0	0	0	42
	3	2	2	5	6	0	2	6	5	0	4	4.5	7.5	2.5	0	0	49.5
	3	2	2	5	6	2	2	5	5	0	4	9	12.5	0	10	0	67.5
	3	2	2	5	6	2	2	1	5	0	0	4.5	5	15	10	0	62.5
	3	2	2	5	6	2	0	6	5	0	4	4.5	5	0	0	2.75	47.25
	2	2	2	5	4	0	2	6	1	3	4	0	5	10	7.5	0	53.5
	3	2	2	5	6	2	2	6	5	0	4	4.5	12.5	2.5	10	4.5	71
	3	2	0	5	6	2	0	5	4	0	4	4.5	15	12.5	10	4.5	77.5
	3	2	2	5	0	2	0	1	5	0	4	0	0	2.5	0	0	26.5
	3	2	2	5	6	0	2	5	5	0	2	0	0	12.5	5	6.5	56
	3	2	2	5	4	0	2	4	3	0	2	9	2.5	2.5	0	0	41
	3	2	2	5	6	2	0	6	5	6	4	9	2.5	5	5	2	64.5
	3	2	2	5	6	0	0	3	1	0	4	4.5	0	0	0	1	31.5
	3	0	2	5	2	2	0	5	2	0	0	4.5	13	2.5	0	3	44
	3	2	2	5	6	0	0	6	5	0	4	9	0	0	5	0	47
	3	2	0	5	6	2	2	6	5	0	0	9	12.5	0	5	0	57.5
Average	2.94	1.89	1.78	5	5.22	1.33	1.11	4.56	4.22	0.5	2.89	5.5	5.58	3.75	4.03	1.54	Average
Global	51.85																Global

- Adjusted marking scheme:

Names	Multiple-choice questions			Development questions								Calculations						Exam total
	#1	#9	#12	#2	#3	#6	#8	#10	#11	#14	#15	#4	#5	#7	#13	#16		
Time required by Mr. Turgeon (minutes)	2	1	3	7	7	1	1	5	4	5	2	5	25	20	20	15	Average	
Original weighting	3	2	2	5	6	2	2	6	5	6	4	9	15	15	10	8	100	
Modified weighting	3	2	2	8	10	4	4	10	8	8	6	6	10	10	5	4	100	
RESULTS	3	2	2	8.0	10.0	4.0	4.0	6.7	8.0	0.0	6.0	6.0	1.7	0.0	2.5	0.0	63.83	
	3	2	2	8.0	10.0	4.0	0.0	1.7	8.0	0.0	6.0	3.0	3.3	0.0	0.0	1.8	52.75	
	3	2	2	8.0	10.0	4.0	4.0	10.0	8.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	57	
	3	2	2	8.0	10.0	0.0	4.0	10.0	8.0	0.0	6.0	3.0	5.0	1.7	0.0	0.0	62.7	
	3	2	2	8.0	10.0	4.0	4.0	8.3	8.0	0.0	6.0	6.0	8.3	0.0	5.0	0.0	74.7	
	3	2	2	8.0	10.0	4.0	4.0	1.7	8.0	0.0	0.0	3.0	3.3	10.0	5.0	0.0	64.0	
	3	2	2	8.0	10.0	4.0	0.0	10.0	8.0	0.0	6.0	3.0	3.3	0.0	0.0	1.4	60.7	
	2	2	2	8.0	6.7	0.0	4.0	10.0	1.6	4.0	6.0	0.0	3.3	6.7	3.8	0.0	60.0	
	3	2	2	8.0	10.0	4.0	4.0	10.0	8.0	0.0	6.0	3.0	8.3	1.7	5.0	2.3	77.3	
	3	2	0	8.0	10.0	4.0	0.0	8.3	6.4	0.0	6.0	3.0	10.0	8.3	5.0	2.3	76.3	
	3	2	2	8.0	0.0	4.0	0.0	1.7	8.0	0.0	6.0	0.0	0.0	1.7	0.0	0.0	36.3	
	3	2	2	8.0	10.0	0.0	4.0	8.3	8.0	0.0	3.0	0.0	0.0	8.3	2.5	3.3	62.4	
	3	2	2	8.0	6.7	0.0	4.0	6.7	4.8	0.0	3.0	6.0	1.7	1.7	0.0	0.0	49.5	
	3	2	2	8.0	10.0	4.0	0.0	10.0	8.0	8.0	6.0	6.0	1.7	3.3	2.5	1.0	75.5	
	3	2	2	8.0	10.0	0.0	0.0	5.0	1.6	0.0	6.0	3.0	0.0	0.0	0.0	0.5	41.1	
	3	0	2	8.0	3.3	4.0	0.0	8.3	3.2	0.0	0.0	3.0	8.7	1.7	0.0	1.5	46.7	
	3	2	2	8.0	10.0	0.0	0.0	10.0	8.0	0.0	6.0	6.0	0.0	0.0	2.5	0.0	57.5	
	3	2	2	8.0	10.0	4.0	4.0	10.0	8.0	0.0	6.0	6.0	8.3	0.0	2.5	0.0	65.5	
Average	2.9	1.9	1.8	8.0	8.7	2.7	2.2	7.6	6.8	0.7	4.3	3.7	3.7	2.5	2.0	0.8	Average	
Global	60.2																Global	

At the end of the exam, participants filled out a pilot exam evaluation form. The evaluation results are as follows:

- 69% of participants found the level of difficulty of the pilot exam to be average and 25% of participants found the level of difficulty of the pilot exam to be high;
- 53% of participants answered that the questions fully covered the course content and 33% answered that there could have been fewer questions;

- 43% of participants had enough time to answer all the questions and 33% would have needed an additional hour;
- 55% of participants thought it was a good idea to have an exam as part of the Advanced RCx Course;
- 59% of participants prefer an exam with a combination of essay questions, multiple-choice questions and True or False questions. The rest of participants prefer all multiple-choice questions;
- 53% of participants needed more examples, 33% needed more exercises and 14% needed more time to prepare for the exam; and
- Finally, 74% of participants prefer to take the exam immediately after the course.

Based on this evaluation, we can conclude that the level of difficulty of the exam was appropriate. The questions fully covered the course content. Less than half of the participants had enough time to finish the exam. More exercises and examples would have better prepared them. The participants prefer to take the exam immediately after the course.

The exam results and the participants' exam evaluation show that better preparation through exercises and more time to answer the questions probably would have increased the average mark.

COMMENTS RECEIVED FROM THE PROJECT TEAM

The project team made the following few comments on the training:

- Module 5 needs to be revised. A distinction must be made between needs monitoring, persistence and use of measuring tools;
- The exercise book needs to be revised based on the manual;
- Consider the possibility of replacing the 3.5-day session with two 2-day sessions;

CONCLUSION AND RECOMMENDATIONS

Lessons identified from the course evaluation

The course evaluation shows that the participants are satisfied with the training.

The analysis of the participants' evaluation also confirmed the value of the French version of the RCx course and showed that the French training material could be completed without major technical modifications. However, to improve the course and make it even more effective, it would be a good idea to reduce the amount of text on the overheads and remove points that are repeated. The course analysis also showed that participants would like to be given the formulas for the most common calculations. Also, presenting a full example of a real RCx project would facilitate comprehension.

The trainers' energy and the interaction between participants helped make the training a success. Many participants made positive comments in this regard.

Having two trainers on hand throughout the 3.5-day training was beneficial and should be maintained in future courses. It also seems strategic to develop a network of trainers that combines technical experience, training skills and knowledge of the learning material.

Participants' comments also showed that there was some confusion between recommissioning and energy efficiency. Properly distinguishing between the two concepts would resolve this issue.

Lesson identified from the pilot exam evaluation

The exam evaluation shows that the level of difficulty of the exam is appropriate. It fully covers the course content. There is good reason to increase the duration of the exam or reduce the number of questions. Doing more examples and exercises in the course would undoubtedly help participants achieve better results.

Response to comments from the project team

Module 5 and the exercises will be improved. However, no major changes will be made. The continuous improvement process, which will be ensured by following up on participants' comments in future sessions and following up on RCx tool development, will help improve the Advanced RCx Course steadily over the years.

It would be practical and beneficial to provide the training in 2 two-day periods in close succession (no more than one week between the two sessions). The first two days could cover Module 0: Course overview to Module 3c: Investigation – Ventilation systems. The last two days would cover the other modules and the exam.

In conclusion, overall, this 3.5-day training seems relevant, adequate and a realistic length in the context of our society's sustainable development. It met the expectations of all participants, who are buildings experts. Therefore, the 3.5-day Advanced RCx Course is ready for large-scale deployment on a regular basis. Its impact will increase as the learning materials improve over time with a range of examples and modular case studies.

Appendix A
Curriculum and Agenda

ABOUT THIS ADVANCED RECOMMISSIONING (RCx) COURSE

This course will cover the recommissioning process: planning, investigation, implementation and hand-off (see RCx Standardized Process Flowchart), and will emulate the actual phases of recommissioning to provide participants with a cohesive understanding of the process from start to finish. A discussion on commissioning, retrocommissioning, and recommissioning will highlight the differences between these processes (design-construction-testing vs. investigation-implementation), as well as the similarities between the two (system testing, trending, etc.). The course will also cover persistence strategies for facility operating staff and 3rd-party recommissioning providers to maintain the benefits of the process over the life of a building.

Training topics include: the system approach, efficient methods for uncovering problems, working with the building staff, calculating savings, implementing findings, providing targeted documentation and training, and on-going commissioning best practices.

Participants will be invited to take part to hands-out group activities based on real data coming from actual recommissioning projects in order to strengthen the principles demonstrated during the course sessions.

Day 1 – Planning

This module focuses on the tasks that typically occur during the planning phase of a recommissioning project. These include, but are not limited to:

- Building screening
- Benchmarking/utility bill analysis
- Project scoping
- Trending and data logging issues
- Engineering fundamentals

Students will participate in group activities based on real-world project data to reinforce the principles demonstrated during the class.

Day 2 and Day 3 –Investigation and Implementation

During the investigation phase, the commissioning provider performs a detailed analysis of operational improvements and energy conservation opportunities. Day 2 and Day 3 of the course will provide participants with a mixture of classroom lecture and group activities to demonstrate how to identify these opportunities. Using engineering fundamentals, methodologies, and tools, students will learn how to assess potential energy savings and report results in a consistent manner. An overview of recommissioning findings and in-depth evaluation of several of the most common measures will expose participants to typical investigation results and examples of energy and cost savings potential. Potential systems for evaluation include:

- Ventilation
- Economizers
- Terminal units
- Energy management systems
- Pumping
- Lighting controls
- Schedule issues
- Proper setpoints

Interactive group activities will reinforce the principles discussed during the class using data from actual recommissioning projects. Results from in-class exercises will be used to illustrate various implementation methodologies and techniques for selling recommissioning services.

Day 4 – Hand-off (half day)

This module focuses on the tasks and deliverables that are typically part of the hand-off phase of the recommissioning process. The discussion will reemphasize how "persistence" and "recommissioning" fit into the big picture of ongoing building performance. Students will learn how to develop a successful on-going commissioning plan to ensure the improvements implemented during the recommissioning process persist over time. The on-going tasks include, but are not limited to:

- Facility staff training
- Re-benchmarking and utility bill analysis
- Best practices for maintaining optimized system operation
- Trending and data analysis techniques used for troubleshooting and performance verification

The discussion will touch upon the International Performance Measurement and Verification Protocol (IPMVP) and how it may impact measurement and verification of the recommissioning project. In-class activities on Day 4 will include the development of a sequence of operations and an operational persistence matrix to demonstrate how persistence strategies are an essential element in the recommissioning process.

Notice: Users should be aware that information offered by non- Government of Canada organizations and thus, that are not subject to the [Official Languages Act](#), may be available only in the language(s) used by the organizations in question.

AGENDA

Day 1

- 8:30 Welcome and course overview – Module 0 – Tab 1
- 9:00 Introduction to Recommissioning (RCx) – Module 1 – Tab 2
 - Process, terminology, needs and benefits
- 10:00 Health break
- 10:15 Phase 1: Planning – Part 1: Pre-screening – Module 2a – Tab 3
 - Building portfolio prioritization, energy bill analysis and benchmarking
- 12:00 Lunch
- 1:00 Phase 1: Planning – Part 2: Scoping – Module 2b – Tab 4
 - Facility walk-through, DDC systems data analysis and RCx plan
- 3:15 Health break
- 3:30 Phase 2: Investigation – Module 3a – Tab 5
 - Objectives and typical investigation procedures
 - Engineering fundamentals

Day 2

- 8:30 Phase 2: Investigation – Module 3b – Tab 6
 - In-depth building investigation
 - Pumping basics
- 10:00 Health break
- 10:15 Phase 2: Investigation – Module 3b – Tab 6
 - In-depth building investigation
 - Diagnostic methods and pumping opportunities
 - Practical example – pumping measures
- 12:00 Lunch
- 1:00 Phase 2: Investigation – Module 3c – Tab 7
 - In-depth building investigation
 - Types of systems
 - Practical example – system identification and RCx opportunities
 - Most common RCx measures
 - Terminal units
 - Practical example – optimizing terminal units
- 3:15 Health break
- 3:30 Phase 2: Investigation – Module 3c – Tab 7
 - In-depth building investigation
 - Fresh air management and recovery of heat from fresh air
 - Practical example – remeasuring fresh airflow
 - Economizer
 - Practical example – restoring an economizer
 - Rooftop units

Day 3

- 8:30 Phase 2: Investigation – Module 3d – Tab 8
- In-depth building investigation
 - Energy management system and controls: roles and challenges
 - Sought-after qualities of EMSs, external data loggers
 - The role of measurement and RCx trend monitoring
 - The 10 most common RCx measures and controls
 - Practical example – optimizing HVAC system schedules
 - Practical example – optimizing lighting schedules
 -
- 10:00 Health break
- 10:15 Phase 2: Investigation – Module 3d – Tab 8
- In-depth building investigation
 - Optimization of control logistics
 - Practical example – dynamic adjustment of the supply temperature
- 12:00 Lunch
- 1:00 Phase 2: Investigation – Module 3d – Tab 8
- In-depth building investigation
 - Calibration and impact on RCx
 - Practical example – Calibrating a moisture sensor
 - Findings Log (common RCx measures)
- 3:00 Health break
- 3:15 Phase 2: Investigation – Module 3e – Tab 9
- Example – Establishing a Findings Log
 - RCx investigation report
- 4:15 Phase 3: Implementation– Module 4 – Tab 10
- Implementation plan and report, including evaluation of savings potential

Day 4

- 8:30 Phase 4: Hand-off and persistence – Module 5 – Tab 11
- Final RCx Report
 - Plan for the next recommissioning project and ongoing commissioning plan
 - Persistence strategies and performance follow-up
- 10:00 Health break
- 10:15 IPMVP – Module 5 – Tab 11
- 11:15 Conclusions and discussions – Module 6 – Tab 12
- 11:30 Course evaluation
- 12:00 Lunch
- 1:00-4:30 Exam
-

Appendix B
Evaluation form given to participants

Module 0: Course overview

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 1: Introduction to RCx

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 2a: Phase 1: Planning – Part 1: Pre-screening

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 2b: Phase 1: Planning – Part 2: Scoping

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 3a: Phase 2: Investigation

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 3b: Phase 2: Investigation – Power plants and pumping

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 4: Phase 3: Implementation

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 5: Phase 4: Hand-off and persistence

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

Module 6: Conclusion

How would you rate the quality of this module?

- Excellent
- Good
- Fair
- Poor

How could we improve this module?

ÉVALUATION DU COURS DANS SON ENSEMBLE

1. Comments

2. How would you rate the overall quality of the training course? Excellent Good Fair Poor

3. Did it met your expectations overall? 5 4 3 2 1
(Rate from 1-5 with 5 being the highest)

4. Would you recommend it to someone else? Yes No

5a. What portions of the training course were the most useful and why?

5b. Is there a subject that should be added or deleted?

6. Do media tools (e.g. computer, PowerPoint presentations, etc.) used was adequate? How can they be improved?

7. Do training tools (e.g. examples, manual, etc.) used was adequate? How can they be improved?

8. How could we improve the course?

9. General comments:

Right of use: I allow Natural Resources Canada to quote my comments above in printed or electronic publications related to Natural Resources Canada: Yes No

Si yes:

Given Name:	Position:	City:	Phone:
Family Name:	Organization:	Province:	E-mail:

10. Objectives, content and trainers	Strongly agree	Mostly agree	Somewhat agree	Do not agree
a) The objectives were clear and precise	4	3	2	1
b) The content met my needs	4	3	2	1
c) The number of hours of training was sufficient	4	3	2	1
d) The objectives were met	4	3	2	1
e) The teaching material provided was useful	4	3	2	1
f) The methodology and techniques used facilitated my training	4	3	2	1
g) The in-depth information and hands-on exercises provided that improved my ability to implement retrocommissioning projects	4	3	2	1
h) The teaching of the importance of integration throughout the entire retrocommissioning process was adequate	4	3	2	1
i) The teaching of efficient methods for uncovering problems in buildings was adequate	4	3	2	1
j) The overall quality of the presentation was excellent	4	3	2	1
k) The value of information to me was high	4	3	2	1
l) The information covered is relevant to my business	4	3	2	1
m) The trainer presented the content well	4	3	2	1
n) The trainer respected each person's learning pace	4	3	2	1
o) The trainer ensured that participants understood the content	4	3	2	1
p) The trainer knowledge of the topics was sufficient	4	3	2	1
q) The trainer presentation skills was appropriate	4	3	2	1
r) Participants concern was well addressed by the trainer	4	3	2	1
s) The trainer stimulated feedbacks efficiently from participants	4	3	2	1
t) The amount of information provided was adequate	4	3	2	1
u) The time to discuss issues with other attendees was adequate	4	3	2	1
v) The time to ask the trainer questions was adequate	4	3	2	1

w) The time devoted to presentations was adequate	4	3	2	1
x) The time devoted to field work was adequate	4	3	2	1
y) The number of workshop attendees was adequate	4	3	2	1
z) The training room size and general accommodation quality was adequate	4	3	2	1

Appendix C
Compilation of evaluations

Module 0: Course overview

How could we improve this module?

- Limit the reading of the provided material.
- Present the training plan in greater detail, discussing it in each module in order to have a more global perspective of the course and its progression.
- Properly place the RCx training in context.
- Add real technical examples.
- Present the agenda or the table of contents in greater detail. Focus less on the context and the stakeholders (required here because of the "pilot" process).
- I appreciated that we discussed a client-centred approach.
- Keep participants' presentations.
- Enjoyed all of the presentations.
- Add more information and references on the benefits of RCx.
- A bit short as to time.

Module 1: Introduction to RCx

How could we improve this module?

- Separate presentation for Q&As (avoid drifting), and avoid specifics—it's an introduction.
- Keep the current format; the trainer's dynamic style fosters exchange and participation from everyone.
- Good introduction; I don't like the idea of attaching an equivalent cost to non-energy benefits, even though these benefits are sizeable.
- The course content is enhanced by Canadian examples of costs/benefits. There appears to be a misprint on page 5: a deliverable is mentioned as required (follow-up report), but is not mentioned in the model on page 3.
- Strong points: interactive nature, concrete examples and cases.
- List the non-energy benefits. Elaborate on changes in the facility's use. If findings clearly show that the standards have not been met = significant increase in energy consumption.
- Harder to follow when interpreting energy bills and consumption curves. Need for this analysis? I appreciated that we discussed reactions and the client-centred approach for the pre-screening or screening of buildings.
- Maintain participant/presenter interaction. More concrete examples to provide the big picture.
- Point of sale, difference between Cx, RCx and troubleshooting. American and 2004 data.
- Could have been covered more quickly, because most people are already familiar with RCx and the PECl process, and mostly, because we will be covering each phase in detail.
- A lot of material, but well distributed.

Module 2a: Phase 1: Planning – Part 1: Pre-screening

How could we improve this module?

- Emphasize the 2nd half of the module instead of the first, the benchmarking approach seems crucial to the decision-making process.
- Reduce the amount of information by including only pre-screening information.
- Remove the lengthy steps from the pre-screening process that are not part of pre-screening.
- Regarding the RCx process matrix, it would be best to clarify that it is based on the American plan having a building portfolio. Phase 1 of planning is the owner's responsibility, and the officer should be paid for his or her participation.
- The title of the module could be adapted. I see the tools presented in this section as being more for evaluating the building's RCx potential, to verify whether it is worthwhile to proceed further. The guide could/should be adapted because for most of this module, it states that we are not dealing with pre-screening.
- Excellent flow.
- Adapt the theoretical section more to what is actually done with the client: simplify the steps, provide a better definition of the deliverables that the client should receive.
- Further simplify the process by providing examples.

- Transfer page 57 and what follows to the next section, or revise the \$ 3,000 estimated to help the owner make his or her selection. Lots of emphasis on energy for the selection – maintenance costs, number of complaints, absenteeism rate not adequately addressed...RCX≠EE. *Emphasize the importance of involving the consultant (with the deliverable) in this step.
- The pre-screening for \$ 3,000 seems to be a lot of work. It's worrisome. The presentation was a little long.
- Be careful: Make it clear that there is no deliverable for this section. This section applies to a building portfolio.
- Better coordination between presenters. Considerable personal experience.
- (+) Well-described, good information. (-) Confusion between pre-screening and screening.
- This module could be covered more quickly, as pre-screening is usually done by the client. On the other hand, the tools presented are interesting, but should be developed further (planning, investigation, and follow-up phases).
- Not well-aligned with the pre-screening content. Process based on a building portfolio.

Module 2b: Phase 1: Planning – Part 2: Scoping

How could we improve this module?

- Re-focus the recommissioning plan presentation without revisiting the specifications of the AEE-HQ-Gaz Metro joint program in full detail.
- Clearly define the support requirements regarding the PECl program.
- Reduce content on slides. More relevant. To give more time for the exercise.
- The example should be tied to Quebec practices. Provide an RCx plan summary at the start of the module.
- The context resulted in confusion during discussions. Application of the program and of RCx should be avoided in the future.
- Gives a good idea of the potential RCx measures. Greater emphasis could be put on the tests of the building's equipment. A typical example of a plan could also be useful.
- It would be useful to have an example of the RCx plan and/or content information of such a plan in the form of a table of contents. There is confusion/difference of opinion on what is in fact RCx, and what is not. Maybe include a list of measures, examples. The exercises should reflect our environment.
- Rework the example by simplifying it, so that people understand the concept and don't go into too much detail.
- A more detailed workshop, more time and provide a concrete example of an RCx plan.
- We suggest very detailed work be undertaken "in moderation." Emphasis to be put on the plan submitted for comments, and on the official, "negotiated" plan.
- The sections on mechanical noise should be reviewed. Just mention to pay attention to noise.
- Make the exercises more concrete. Visit a mechanical room in operation and do a walk-through in an operational building.
- Unclear documents and exercises.
- Strong theoretical part and weak exercise part (too long, poorly structured). Review the example: reduce the system's scope or increase the time allotted to complete it.
- More precise; fewer complicated, imprecise exercises. Request for suggested verifications, but the course did not provide us with any training on the possible types of prerequisites.
- Exercise could be improved.
- Use a less complex example to allow participants to have more focus and enough time to complete the practical forms. Prepare complete answers.
- The section is too technical, exercises should be reviewed.

Module 3a: Phase 2: Investigation

How could we improve this module?

- Provide a few more examples of cases that enable the linking of data with possibilities.
- Add specific examples of heating calculations. The engineering principles beside the formulas. Pages 28 and 27 are identical.

- Maybe make the investigation and testing section more dynamic by adding photos of equipment with time/pressure benchmarks for major readings.
- It would be worthwhile to put a greater emphasis on functional testing, and to give examples. The analysis of meteorological data could also be seen in greater depth, describing the potential indicators, etc.
- Provide an example of an investigative report. Good references given.
- Incorporate examples of functional tests into the presentation.
- Provide an example (workshop) with a degree day/consumption analysis.
- Good entry into material for sections that follow. Difficult to evaluate.
- Perhaps mention that linear regression is not required in all projects. When the client needs M&V.
- A few practical examples would be valuable.
- The part on analysis by regression was a little difficult for someone who does little energy analysis, but it makes one aware of its importance.
- Review the translation (word selection).
- (+) Liked the presentation of the formulas and the accompanying analytical logic. (-) Was too long.
- More detail on the functional tests.

Phase 3b: Phase 2: Investigation – Power plants and pumping

How could we improve this module?

- Based on the target objective, the calculation component could be eliminated, but the presentation of the exercise is relevant.
- Provide an example of a pump that provides greater energy savings to encourage the effort invested. Present the exercise (the activity) to be done in greater detail before the team work. It was well-presented after the results. The first example before the activity was well-presented.
- Calculating energy savings (exercises) took a lot of the exercise's time (+/- appreciated). Diagrams of the various pumping strategies might be more appropriate (primary/secondary, pump in series/parallel, 2 way/3 way).
- The material is interesting and practical. However, the loss-of-load calculations were long, and added nothing. The exercise needs to be laid out better; we were a little lost, which curve belongs to which system, what to calculate, etc.
- The example should focus more on the end result, meaning diagnostics and savings instead of calculating loss of load, since this adds nothing. Also, the example should be with "drive", because the impeller is rarely trimmed.
- Do not do the load calculation exercise, just present it. Take more time to discuss the approach.
- Very interesting, but too quick.
- The pumping investigation must be shortened further. Compared to the investigation cost, the savings in electricity are rarely worthwhile.
- Finally, an example!
- Exercise not clearly defined. Formulas not clear (exercise book).
- Very good theoretical part, good examples. The exercises were too long for the allotted time; they should focus on RCx logic (analysis) instead of HVAC calculations.
- (-) The exercises' emphasis was on calculations instead of on conclusions. Too much time spent on calculation, not enough time for analysis. (+) Exercises force participants to think and remain involved in the course.
- The exercise should be reviewed to be more relevant (the part on load loss calculations). However, the rest of the exercise done as a group is interesting and relevant. Clarify what must be verified before conducting the test with the throttling valve completely open (ambiguity about risks associated with this test).
- Choose an example that can be completed in 30 minutes.
- Is it truly necessary in recommissioning. Very technical.

Module 3c: Phase 2: Investigation – Ventilation systems

How could we improve this module?

- A lot of material on ventilation. There is a lot of theory to reassimilate. It is a very large volume of information; I noted that a number of people (including myself) "skipped out" in the last 90 minutes. The exercises could be sent and reviewed with the corresponding Excel files. Use of a laptop would greatly facilitate the approach during the exercises.
- Provide formulas alongside the exercises. Demonstrate at least the calculation of a result for the exercises in tab 9 of the exercise book. Difficult to follow (the exercises). Verify and apply the formulas in tab 5.
- The exercises should be taken out and replaced by examples only.
- The technical exercises are too difficult, since we do not have the necessary tools for the calculations, computers. Furthermore, the pages of the sub-exercises are not well-defined: a USB key with the exercises on Excel, however, would be useful. I am not sure that the calculation exercises for pumping energy savings were relevant. The pages with the notes at the bottom should be updated: the current ones are better and clearer.
- The most interesting part of the module involved the examples from screen dumps, which led to exchanges between the participants. The exercises were interesting and well-chosen, but as previously mentioned, the calculations portion was unnecessary.
- It seemed like there was not enough time for the investigation, compared to the start of the course, which was slower. The exercises should all use the same building so that we "save" in efficiency while we learn about the building. The tables should be completed to avoid having to do all of the calculations to "understand" the conclusion. Maybe only a few boxes should be empty to practice the calculations.
- To simplify the examples, it would be better to make a single case study that we would study in greater depth over the whole course. (Module 1 to Module 6). At the end of the course, the study could enable us to produce a standard report for a recommissioning for the client. Correct all misprints in the presentation.
- Use a concrete example in a mechanical room, e.g. the system that feeds the classroom and comment on the building management system data.
- We repeated the same things without ever clarifying. Too quick, it provided some ideas, but... The data in the exercises is unclear, and the questions are awkwardly phrased. They made us do calculations without giving us the time to understand the data – pointless. A relaxed demonstration (unhurried and making the participants respond) would be more effective. Everyone is doing the calculations without understanding them, and there is little time left for explanations. It takes away the appeal of RCx. More interesting after the break.
- I would focus the training more on what is required in terms of deliverables. Then, on the ways to get there: ideas for measures, ideas on tests, some examples, etc., but take out the savings calculation part; I think that firms all have their methods and will be more or less aggressive.
- The exercises were reviewed too quickly. A lot of material in a short amount of time. Add more examples of calculations with precise figures.
- Adapt the exercises better.
- Very good theoretical part, clear presentation, good practical examples. Once again, the presenters' support and exchanges with the participants were very positive. To revise: the length of exercises, shorter with more explanations. Learning would be improved (maybe more results from practical/completed projects).
- (+) A lot of relevant information. (-) We had to go over some parts very quickly, since there was too much information to cover. The exercises could focus on one system instead of three to reduce the calculations and increase the comprehension time.
- Clarify the exercises and hand out a corrected version. Aside from that, very interesting. I appreciated the presenters' input. I believe that it would be more worthwhile to show the process in front of the class in order to perform the calculations on the board. Maybe less relevant to make us calculate all the boxes. It would be important to clearly establish the hypotheses. A good method would be an exchange between everyone to identify the hypotheses. As for the slides, the added content is relevant and fairly complete.
- Revise the calculation tables for the ventilation exercise. Unify the measurement units. Develop exercises that can be completed in the allotted period.

- Is it really necessary to train engineers in commissioning and energy efficiency on calculation concepts that we use daily? I would have preferred a course on investigative reports over a course on calculations.

Module 3d: Phase 2: Investigation – Measurement and control systems

How could we improve this module?

- There are adjustments to be made in the practical exercise approach. An interactive approach seems much more useful to me. The exchange enables discussion of a range of details, and it improved participants' comprehension and competence. As a whole, the investigation component could be presented as a specific case study, while enabling interaction between participants and the presenter about certain details on which they can elaborate.
- Put page 26 before the graphs, after page 7. Just like with the other modules, provide the exercise formulas. Change the activity so that participants don't get lost in the calculations. Discuss alternate hypotheses. In general, I found that there was a lot of text on each page for this module with long sentences, some of which were repeated from other modules.
- In general, the graphics are useless, depending on the people in the room. Present advantages other than energy ones, when applicable.
- The level of content is appropriate, but the level of calculations (examples) is too complex. As discussed in the course, using a warehouse with a roof, a humidifier and a heating/cooling coil would make the exercise much simpler and would encourage everyone to participate. An Excel tab = an HVAC-R element. Encourage group resolution.
- More tools, for potential diagnostics.
- More diagnostic examples/exercises, maybe 1 per section/possible measure.
- Better identify the hypotheses and provide a more detailed description of the problem's context. Separate the recommissioning measures and the hypotheses to gain a better understanding, and calculate the energy before and after for each of the problems. Complete 90% of each of the examples beforehand, and with the group, review the calculation method used to obtain the result. Reduce the manual calculation to be done in class by participants to a minimum—waste of time. Perform a review of the typical measures recommended in an investigation, e.g.: a portable Hioki data logger, a portable temperature and humidity sensor.
- Give examples, emphasize the approach, and give the formulas used. Provide concrete, interactive examples.
- Revise the wording of the problems. Still some calculations that are more or less useful in the exercises. Focus on the formulas and hypotheses, rather than on the calculations. More examples of functional analytical data tests, "traps" (false conclusions), crossover effects and any other real-life experiences would also be appreciated. Emphasize effects other than energy efficiency (maintenance, operations).
- It would be good to review the important role of the energy management system. The section on data recording is too precise, and the examples (p. 317, p. 372, p. 363) are questionable. Also review the benchmarking plan: what is required, frequency. The activities should all be done together to notice the subtle effects of the changes. Lack of information in the exercises. Provide resolved exercises. Concentrate on the process and not on the calculations.
- Document the exercises better, add columns (under calculations: % used, ...) in the exercise tables. Very good theory: maintain interaction between the participants and the presenter.
- (+) Good vision, good example, good discussion. (-) Lack of an example of a real result. Corrosion if there's too much humidity.
- Maybe some repetition. Interesting exercises (calculation approach).
- Work to be done on the exercises. Suggest creating examples and exercises with all of the hypotheses and information presented.

Module 3e: Phase 2: Investigation – Findings log and investigation report

How could we improve this module?

- Too short, considering its importance. Maybe improve it with examples.

- Include a brief example of an investigative report.
- There could be more examples of reports.
- The log example in the manual should have been more refined. What was the purpose of page 166 of the exercise book.
- Should focus more on the financial aid program. More emphasis must be put on the non-economic advantages in the report, as presented in the module.
- Aside from the comments discussed in class on the exercises, the examples were very good.
- Update the presentation according to the financial aid program requirements.
- Provide a simple example, not too detailed, of the log's form and content.
- Very short, considering that it's what should sell the next part... Complete models that comply with NRCan standards would be appreciated. Once more, greater emphasis should be placed on the objectives set out with the client.
- The formulas and explanations are clear.
- Good résumé of the requirements (optional/mandatory). Good presentation, short, effective.
- (+) Well-structured. (-) Distinction with the implemented programs. Must provide clarification on programs and requirements in terms of deliverables.
- Provide an example for those unfamiliar with this type of report. For example, a sample table of contents.
- General comment: enough with maintaining focus, and avoid tangents that are too time-consuming.
- Not well developed, the most important section of the course. More description of the content.

Module 4: Phase 3: Implementation

How could we improve this module?

- Much too brief. Following an example would be relevant. "How to sell the project" does not belong in this section.
- Exclude pages 13 and 14.
- We went over this section very quickly. The two examples from the exercise manual are quite different, and we cannot define whether they are complementary or different. The plan information (contained in 5 points) comes from previous sections, and there should be a group exercise to identify or make reference to the source of the information.
- The economic analysis portion was gone over very quickly. It would have been better to develop this aspect in greater detail. The remaining information was fairly unimportant.
- Less relevant.
- This module should be presented in the investigative report during the presentation on savings and investment costs.
- Do not go into too much detail in this part.
- With more concrete examples by removing the "sale" part (it must be done prior to implementation). The RCx officer should be present for implementation, regardless of the contracting approach.
- The capitalization rate section did not seem very clear.
- Elements were well summarized, I like its compactness.
- (+) Very quick and concrete. (-) Fewer examples than the other modules.
- Personally, I mentioned problems or complications that could arise during implementation. For example, after proposing a measure in the investigation, another measure might require further investigation, or be abandoned, as certain parameters are unknown.
- Pay attention to the structure of the interventions over time.

Module 5: Phase 4: Hand-off and persistence

How could we improve this module?

- The theory is correct, but it may be the aspect that has to be done the most expertly, to ensure the success of the entire approach. There is also confusion interpreting terms, etc.

Suggestion: we do not see the terms "verification list" and "dashboard", which, to me, seem more basic than others, such as "log."

- Include a table of contents from a final report. In the notebook, there are four pages listing content. I would find it easier to have everything on one page. Add who should be there for training. Remove page 24 (already seen in the other modules). Develop a separate IPMVP module.
- This module should be separate from the IPMVP.
- Some slides are not up to date. There were slight nuances or ambiguities in the exercise book, the persistence matrix and the implementation plan.
- Too much emphasis on measurement. The rest of the module on hand-off and persistence (measures that generally do not last).
- Separate measurement and persistence (the modules). Note: the IPMVP plans to use option C if savings are predicted to be greater than 1%, not 5%. Confusing explanation during training.
- Separate the hand-off and persistence modules. At the end of each module, a link should be made between the government program requirements and the recommissioning. This link is not always evident in each module.
- Make a distinction between the grant program requirements and the RCx standards.
- Somewhat jumbled documentation. Lots of time on "extreme" follow-up not required by the programs. Improve methods for monitoring/demonstrating non-energy gains. A lot of emphasis on energy.
- Clarify and divide hand-off and persistence. Review the titles and tables for the activities. The sequence of operations is 10 pages!
- Put the references in the slides to avoid searching the exercise book. Separate the persistence and IPMVP modules.
- Define the minimum obligation and involvement required.
- Change the order of the presentation. More examples of deliverables.
- (+) IPMVP—Interesting presentation. (-) Inadequate focus on non-energy gains, and how to demonstrate them.
- Integrate the ideas presented by Michel (CUSUM and mobile consumption over 12 months) into the slides. Arrange slides in order.
- Change the exercise with less information to assimilate in the short time available, to enable better understanding of the concept.
- Very dynamic, interesting and applicable module.

Module 6: Conclusion

How could we improve this module?

- Try not to repeat actions in the various phases. For example, the same phases (pages 8 and 10) in implementation and hand-off. Missing a persistence phase. In the investigation module or phase, remove the engineering principles and theories. It's basic material that we should already know. Determining energy savings possibilities is a separate course; I don't think that it should be part of RCx training. I'm looking mostly for the right method to use, because I'm doing the RCx.
- Good conclusion.
- Not very useful if there is no review of the crucial points.
- Very good résumé.
- (+) Short, repeats the expectations. (-) Organization (e.g. training - hand-off) of the slides.
- Clarify the training ambiguity, which is found in the implementation and transfer phases.
- Poorly defined phases.

IPMVP module

- Adequate approach. There are no technical details, but the relevance and advantages of M&V are emphasized to validate and confirm the project's successes.
- As a whole, everything went quickly. Regular review of the process as a whole and of the phase being discussed.

Vareannes		20011-03-15 to 2011-03-18												Q10																																							
Question #	Q2	Q3	Q4	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	Average	Global																						
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7	6	5	1	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	1	4	4	3,8																					
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10	6	4	1	4	3	3	2	3	3	3	3	4	3	3	4	4	4	3	4	4	4	4	4	4	4	4	4	3	3	4	4	3,5																					
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18	3	3	1	2	2,5	3	2	2,5	3	3	3,5	2	4	4	4	4	4	4	4	4	4	4	4	2	3	3	3	3	3	3,5	3,1																						
Average	4,1	3,8	0,9	3,2	3,1	3,2	3,1	2,9	2,5	2,8	3,0	3,3	3,2	3,2	3,7	3,6	3,7	4,0	3,6	3,7	3,8	2,9	3,1	3,6	3,1	1,2	3,8	3,9	3,2	3,1	3,25																						
Global	68%	76%	94%	80%																								81%																									

Q5a: What portions were the most useful and why?

- The first two days.
- The trainers' work and real-life experiences.
- Planning and approach for the investigation.
- Composition of the deliverables, content of the reports.
- Planning and implementation.
- More emphasis on parts relating to RCx potential diagnostics and exchanges between participants.
- Preselection, planning and investigation sections.
- The investigation phase, because of the practical examples.
- Concrete examples of problems and crossover effects. Persistence module – it's the main focus for RCx.
- What is payable in the deliverables.
- Clarifying steps within the RCx process.
- Investigative method.
- Case examples, course conclusion, useful links (Web site), standards, software.
- Investigative method—functional testing, structures and processes, information from real experiences and the dynamism of the class.
- Thermal power plant, because of less experience at this level, discussions and calculation methods for crossover effects, real experiences shared by the presenters.
- Elaboration of the procedure in every step.

Q5b: Do you have a suggestion for a topic that we should add or remove?

- NPV (calculation and relevance)
- Add a section on the most common problems in the industry.
- Remove the "technical calculation" component, but instead present investigative approaches in a more general way (PFCS).
- Add more developed report examples, and remove the very technical parts.
- Less about pump impellers and more on pumping strategy.
- The calculations in the exercises were superfluous. It was more interesting to discuss the exercises than to do them.
- The content was very appropriate.
- Eliminate (simplify) the exercises to be completed in groups, do a case study applicable to Quebec that we refer to throughout the course.
- Balancing (develop this aspect more).
- How to convince a client.
- Clearly establish the difference between RCx and a traditional energy saving project.
- Visit a physical site (pumping test).
- Define simplified firm indices, study by regression (explain more).
- Remove the idea of potential financial aid, and focus only on the concept.
- Add examples of non-energy gains.
- Review the way of doing the group exercises.
- Add a section that covers an actual case of a full project. It should be at the end, replacing the MEV information. MEV can just be mentioned.

Q6: Were the media tools (e.g. computers, PowerPoint, etc.) used adequate? How can they be improved?

- In general, yes/good (8x).
- Organize the book and insert points to replace the sentences.
- Increase the distinctions between the sentences and the quality of language.
- The reviewed examples should be on a USB key, which would generate more participation.
- The PowerPoint presentation was clear and detailed.
- Eliminate the Excel calculation sheets. Give a detailed copy of the calculations to participants to facilitate comprehension and reduce wasted time.
- Provide the Excel files for the calculations.
- Presentation = paper document. Unnecessary, it makes for a short, less dynamic presentation.

- Review the link between the sections.
- Correct mistakes, frame exercises better, supply electronic versions of notes.
- Some slides had too much information; others were repetitive or irrelevant.
- The slides often have too much information.

Q7: Were the training aids used (e.g. examples, manual, etc.) adequate? How can they be improved?

- Good or very good (4x)
- Make a connection between the course volume and the exercise volume.
- Make the book more compact, put two slides/page. Also improves the reading if the text is smaller (more visual).
- The exercise manual does not follow the study manual's logical order.
- The example and exercise book should be revised.
- Better assembly.
- The document was detailed, but it was sometimes confusing. The exercise book should be put in proper order, ensuring that all of the information is correct, etc.
- Put less text on the slides (too much text = loss of participant's attention). Remove all redundant slides.
- PPT format not required. Could be in electronic format instead.
- The classification in the activity book should be revised.
- Better and more interactive exercises.
- Add actual cases.
- USB key with manual.
- Do the exercises in a more open manner. Show the equations used in the Excel tables.
- Add more reference articles.

Q8: Are there ways that we can improve the course?

- Put less emphasis on energy efficiency.
- Rename the course if applicable for (Hydro-Québec and Gaz Métro).
- Cut it by one day by separating the technical calculation component (to be taken later if required).
- Better structure.
- Encourage exchanges between participants, more diagnostics/opportunity for all technical modules, description of work methods, instruments.
- The implementation part was weak, as was the hand-off part, which has a lot of material. We could save time by eliminating repetition.
- At the end of every module, a conclusion slide and a slide repeating the office program's requirements must be presented.
- More differentiation with the energy efficiency project. Provide models for tables, electronic reports (non-mandatory and adaptable).
- Maybe rework the course's main goal: explain what RCx is, and what is expected. Eliminate the calculations and technicalities related to savings.
- Provide more solved examples.
- Exercises.
- Improve the structure/timing for the exercises: more time, electronic format, and provide more technical material (formulas, theorems) to focus training more on the RCx concept rather than engineering.
- Fewer calculations, more diagnostics, encourage inter-group discussions, change places every day.
- Go over the slides again to ensure that everything is linked, and that there is less repetition. Put the exercise sheets in the right order. Hand out the corrected exercises.
- Need for practical exercises. The exercises should be simplified so that they can be done in the allotted time.

Q9: General comments:

- The course is a departure from the very definition of RCx. Too much emphasis was placed on energy efficiency, and very little on building maintenance, comfort and optimization in general. However, it may be that my understanding of RCx is mistaken.
- Provide more examples, physically show what a completed RCx document looks like. Trainers possessed strong knowledge.
- Make participants clearly understand that the training is not directly associated with AEE certification.
- Excellent trainers.
- The course enables you to cover all the good operating practices for RCx, to determine systems' potential, and provide the knowledge that every RCx officer should have.
- Even if it's a challenge, it would be beneficial to have the course in three days and provide a recap of the crucial ideas in the morning.
- Good training in general, and good approach for delivering a functional project to a client.
- Add a Quebec building that has been the subject of an RCx into the course.
- Very good. It was a shame not to have visits from HQ and Gaz Métro, and to get little information from the AEE.
- Present a concrete example of an RCx report.
- Keep the participant/trainer exchanges.
- The training could be shorter.

Appendix D
Exam instructions and evaluation form

INSTRUCTIONS

1. - You have two (2) hours to complete this exam, which will evaluate the knowledge acquired at Natural Resources Canada's Advanced RCx Course (pilot version) from March 15 to 18, 2011.
- 2 - No points will be deducted for wrong answers.
- 3- If, before or during the exam session, you experience physical or psychological discomfort of such magnitude that it may affect your performance, it is your responsibility to notify us that you cannot write or continue your test. If you decide to write or continue despite your discomfort, you must accept the test results and the re-testing conditions. If you must leave the room during the exam, you can do so, but no extra time will be given to you.
- 4 - You can only write on the questionnaire or the worksheet provided. Please ensure that your name is clearly written on the first page of this exam.
- 5 - The following reference documents are permitted:
 - Course Notebook – Advanced RCx Course - 3rd edition – March 15, 2011 pilot version
 - Course Examples and Exercises Book – Advanced RCx Course - 3rd edition – March 15, 2011 pilot version
- 6 - If you don't have enough space in which to write your answer, use the paper provided, indicating your name at the top of the sheet, as well as the question number that you are answering.
- 7 - We ask that you keep the contents of this exam confidential.
- 7 - You cannot communicate with others during the exam session.
- 8 - Please turn off your cellular phone or pager during the exam session.

Good luck!

EXAM EVALUATION FORM

1. How did you find the **degree of difficulty of the exam?**

Comments:

- Too low
- Low
- Average
- High
- Too high

2. Did the questions fully cover the course content?

Comments:

(If applicable, specify the parts of the course that were not covered on the Exam.)

- Yes
- If No:
 - There could have been fewer questions
 - More questions are needed

3. Did you have enough time to answer all of the questions?

Comments:

- Yes
- If No:
 - 1 more hour would be adequate
 - Other – Specify: _____

4. In your opinion, doing an exam as part of the Advanced RCx Course is:

Comments:

- Useless
- Desirable
- Necessary
- Very useful
- Indispensable

5. For this type of course, do you prefer an exam with:

Comments:

- Essay questions
- Multiple-choice questions
- True or False questions
- A combination of the 3 mentioned above
- Other – Specify

6. Did you need more preparation?

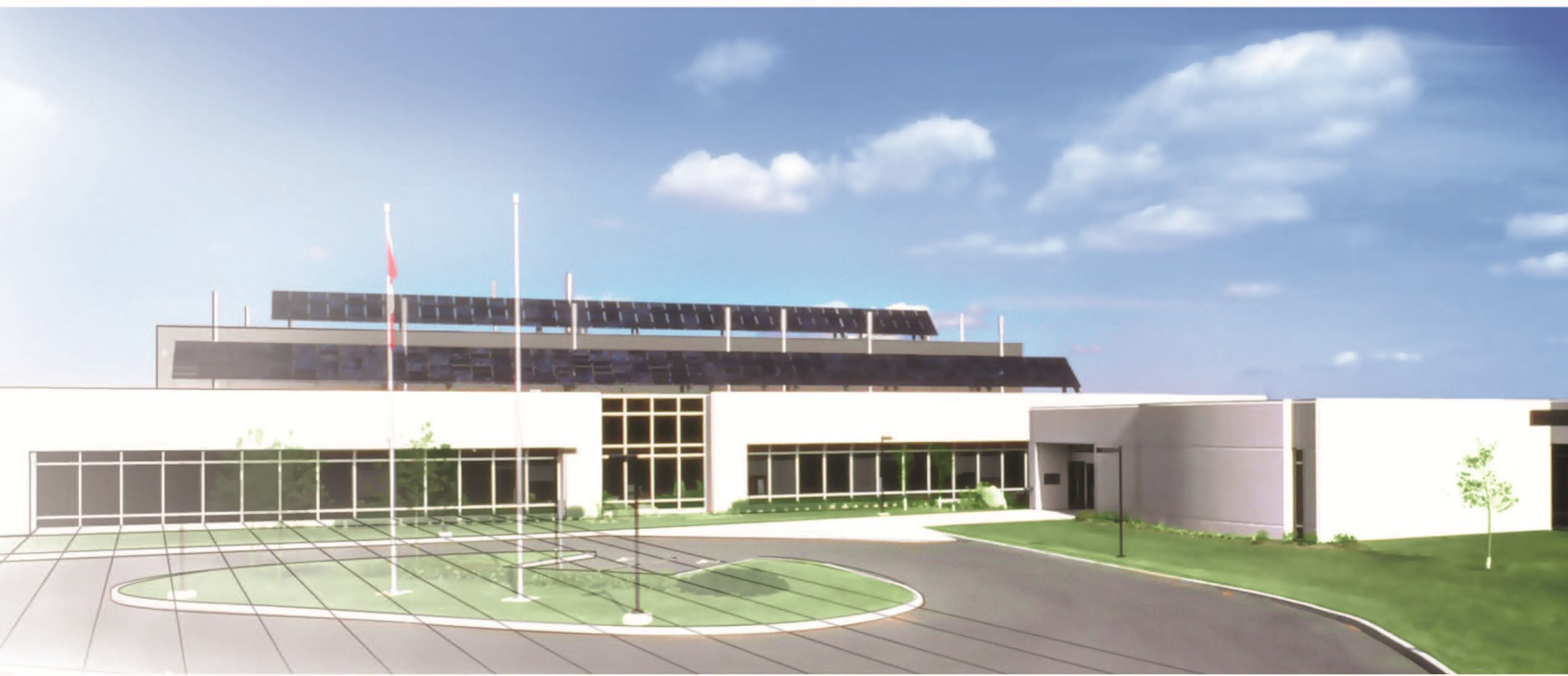
Comments:

- More time
- More exercises
- More examples

7. When would you prefer to write the exam?

Comments:

- Immediately following the Course.
- A number of days after completing the Course.
- Other – Specify



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