



Master Thesis Project Guidelines

For Students, Promoters and Mentors

Academic year 2020-2021

November 2020

Nele Kesteloot (SCK•CEN), Geert Van den Branden (KU Leuven), Gert Van den Eynde (SCK•CEN)

Questions and remarks concerning these guidelines can be sent to: bnen@sckcen.be



Table of Contents

Table of Contents.....	2
1. General principles	3
1.1. Didactical objectives.....	3
1.2. Structure of a master thesis project.....	3
1.3. Requirements for a good master thesis project.....	4
1.4. Two options	4
1.5. Coaching and supervision	4
1.6. Evaluation	5
1.7. Student work load	6
2. Getting started.....	6
2.1. Submission of a proposal.....	6
2.2. Defining the objectives	6
2.3. Literature survey.....	6
3. Interim reporting.....	7
3.1. Purpose.....	7
3.2. Interim reporting to the mentor	8
3.3. Interim reporting to the promotor	8
3.4. Main intermediate report.....	8
4. Master thesis project text.....	9
4.1. General principles.....	9
4.2. Content	9
4.3. Copyright message	10
4.4. Electronic version.....	10
4.5. Confidentiality.....	11
5. Master thesis Paper	11
5.1. General principles.....	11
5.2. Content.....	12
5.3. Electronic version.....	13
6. All's well that ends well.....	13
6.1. Submitting	13
6.2. Thesis summary page	14
6.3. Final master thesis presentation.....	14
7. European Master of Science in Nuclear Engineering.....	14
8. Further guidelines.....	15
8.1. Administrative guidelines.....	15
8.2. Writing in English.....	15
8.3. Tips and tricks	16

Master Thesis Project Guidelines

For Students, Promoters and Mentors

1. General principles

1.1. Didactical objectives

The master thesis project is a major component of the Master of Science in Nuclear Engineering programme of the Belgian Nuclear higher Education Network. It focuses on an **important problem with scientific value** in the nuclear engineering field.

The didactical objectives of the master thesis project incorporate the general didactical objectives of the nuclear engineering master programme such as:

- to educate the students toward analytic, resourceful and inventive nuclear engineers;
- to train students by making full use of the unique nuclear research and industrial know-how in Belgium;
- to train students to maintain a strict safety culture;
- to develop the students' communicational skills in the nuclear engineering field.

Next to those, the master thesis project has some specific didactical objectives as:

- to **work independently**;
- to **use creativity**;
- to follow the **scientific research methodology**.

1.2. Structure of a master thesis project

A master thesis typically has the following phases:

- problem delineation: objectives, scope, limitations: in consultation with the promoter(s) and mentor(s),
- literature survey,
- problem analysis,
- problem solving alternatives,
- selected approach in detail,

- implementation and results,
- conclusions and recommendations.

1.3. Requirements for a good master thesis project

In order to meet the standards set out by the BNEN, a master thesis project has to fulfil the following requirements:

- the thesis should be a genuine research project carried out in a company, safety authority, research institute or university focusing on an important problem in the nuclear engineering field;
- a master thesis is more than a standard application of theory; rather it concerns:
 - new application areas for proven techniques;
 - new techniques for known problem types;
- the master thesis should have the two main qualities of scientific research: objectivity and reproducibility. Assumptions must be formulated, all claims must be documented, literature references must be clearly stated, conclusions must be the outcome of research, etc. ;
- the students should prove thorough insight in the techniques used;
- the students should show good communicational skills in writing and in orally presenting the final master thesis text and the interim reports.

1.4. Two options

Two options exist for the final master thesis:

- to write a **classical master thesis text** (see Chapter 4);
- to write a scientific **publishable paper** (see Chapter 5).

1.5. Coaching and supervision

Every master thesis project has one or two promoters and one or two mentors who are responsible for coaching, and two or more assessors who, together with the promoters and mentors, form the **thesis examination committee**.

- The **promoter** is an (associate) faculty member of one of the participating universities of the Belgian Nuclear higher Education Network under whose responsibility the master project is executed.
- The **mentor** is i) a research associate belonging to one of the participating institutions of the Belgian Nuclear higher Education Network and/or ii) a representative of the company

or research institute where the student does his/her research. The mentor coordinates the thesis work, can help to collect interesting literature, gives theoretical and practical guidance, reads the preliminary thesis text and makes suggestions for corrections.

- The **assessors** are faculty or research members of one of the BNEN institutions; or external experts, chosen for their competence, who are asked by the BNEN Steering Committee to evaluate the master thesis project from an external point of view.

For administrative reasons, it is necessary that the promoter or at least one assessor should be a faculty member of the student's university of registration.

1.6. Evaluation

Each master thesis project will be jointly evaluated by the promoter(s), the assessors and the mentor(s). A master thesis project is evaluated by a score between 0 and 20. The respective scores are defined as follows:

- <10 absolutely unsatisfactory: master thesis work is not as required despite suggestions of mentor and promoter;
- 10 acceptable but weak in volume and/or contents;
- 11 rather poor master thesis;
- 12 master thesis is OK: "cum fructu";
- 13 good master thesis;
- 14 good master thesis: "cum laude";
- 15 better-than-average master thesis: a well-deserved "cum laude";
- 16 very good master thesis (creative, hard working,...), worth the label "magna cum laude";
- ≥17 an excellent master thesis, which can serve as an example for years to come.

The evaluation is based on the following criteria:

- originality,
- problem solving creativity,
- thoroughness (are all problems tackled?),
- effort,
- independent work,
- punctuality,

- final text quality (logical structure, clear message, scientific style, correct usage of English language),
- intermediate reporting,
- final thesis presentation.

1.7. Student work load

The master thesis is rated at 33% of the students total work load, i.e. 20 credit points.

2. Getting started

2.1. Submission of a proposal

A master thesis research starts with the selection of a suitable thesis topic.

- Students are encouraged to propose a master thesis subject themselves.
- Proposals for the master thesis are to be approved by the BNEN Academic Committee.
- A proposal consists at least of: a title, a one page abstract and a date.
- A proposal might already suggest a promoter and a mentor.
- Students are urged to submit a proposal as soon as possible. This is extremely true for students registered for the Master programme in a unique year. These students may already start preparing their thesis in Summer.
- The BNEN Academic Committee decides on a promoter and at least two assessors.

2.2. Defining the objectives

A first meeting with the student, the promoter(s) and the mentor(s) will be held, where the objectives of the master thesis are developed in more detail.

2.3. Literature survey

The literature survey is an important part of a master thesis and has a double aim. The first one is **to introduce the student to a brand-new domain** and to provide a deeper insight in this domain. The second one is **to prevent the student from re-inventing the wheel**.

A good survey of the literature on the subject starts with several basic works e.g. books, review papers in scientific journals, working papers, laboratory or company reports, computer searches and internet, which have to be complemented with more specific papers and books.

References can be found in the bibliographies of basic works, textbooks, theses from past years, and also in the databases of the university libraries or the library of the SCK•CEN. The thesis mentor and promoter will help to start the literature search, but most efforts will be expected from the students' side.

A good survey is **more than a summary of the things read**. Students have to analyze critically what they have read: compare the advantages and the disadvantages of different methods; why can you use certain methods for the master thesis and not the other ones.

In the literature study (and in the remaining part of the master thesis) references should be clear and complete, so that the reader can **easily find all the referenced works**. Only journals, books and other consulted works, that are referred to in the text, are included in the reference list.

Plagiarism, ie copying information from a book, an article or the internet without mentioning its source or suggesting that it is their own work, will not be tolerated. There will be sanctions for a master thesis with obvious signs of plagiarism.

3. Interim reporting

3.1. Purpose

The aim of interim reporting is certainly not to burden the students with extra work, but to give them the opportunity to arrange their thoughts nicely on paper. From experience it is known, that without this interim reporting it is much more difficult to write a well-structured thesis text afterwards. Furthermore, this interim reporting gives promoters, mentors and advisors an efficient way to **follow-up the progress of the master thesis project**, to discuss results, to handle possible difficulties, to schedule a further plan, etc.

Therefore, in the course of their master thesis project, students will contact the promoter (not the mentor) once a month about their thesis research. This reporting can be in writing (e.g. by sending a 1 page progress report) or orally. The quality of the intermediate reporting is an integral part of the evaluation process.

3.2. Interim reporting to the mentor

It is very important that the students consult with their thesis mentor very regularly (at least once every two weeks). Only this way a sufficient and accurate accompaniment of the thesis work is possible. Every important meeting with the mentor will result in a short report (maximum 2 pages) in which further actions (with deadlines and responsibilities) should be emphasized. A copy of this report will be given to the mentor(s).

3.3. Interim reporting to the promoter

The students will contact the promoter once a month about their thesis research. This reporting can be in writing (e.g. by sending a 1 page progress report) or orally. Every meeting with the promoter will result in a short report (maximum 2 pages) in which further actions (with deadlines and responsibilities) should be emphasized. A copy of this report will be given to the promoter(s) and mentor(s).

3.4. Main intermediate report

At an intermediate point in their research activity, fixed in consultation with the promoter and mentor, the students prepare an **interim report** about their thesis research to be **presented orally** to the thesis examination committee. The duration of this presentation should not exceed 15 minutes. In consultation with the mentor or promoter, other people can attend the meeting if that would give them the opportunity to make suggestions and give advice.

This intermediate thesis presentation should contain the following parts:

- activity report: the activities done so forth are summarised in this part;
- results and discussion;
- problems to be discussed;
- detailed work schedule for the following thesis phases.

3.5. Three key dates

The students are offered three possibilities per academic year to present their master thesis work. Typically the first one will be early February, the second one will be linked to the deliberation and proclamation end of June and the third one to the deliberation and proclamation end of August.

Students are required to have at least one intermediate thesis presentation before the thesis examination committee before being allowed to do a final presentation. The choice of when to hold their intermediate presentation and when their final defence is up to the students. For example a

student can have his/her intermediate presentation in February and a final in August. Even so, he/she could have done his/her intermediate presentation in June and his/her final one in August.

4. Master thesis project text

4.1. General principles

A master thesis text is an elaborate written report of the work done during the completion of the master thesis project, not by giving an overview of the amount of work done, but by:

- explaining the problem and the solution methods used or developed;
- transferring information acquired during the thesis research;
- defending a 'thesis';
- making suggestions for directions of further research;
- convincing the reader to take certain measures.

A master thesis text should be **self-contained**, i.e. the reader should be able to understand the objectives, working methods, results and conclusions without necessarily having to consult other books or papers.

The audience of a master thesis text are of course the promoter(s), mentor(s) and assessors, but, possibly also engineers and scientists working or interested in the field of study of the thesis research; and by elaboration all of whom may be considered to have general nuclear engineering knowledge and access to scientific literature.

4.2. Content

Before starting to write the final thesis text, students should **make a detailed outline** of their master thesis and discuss it with the mentor(s).

The master thesis text is **written in English**.

A master thesis contains the following items:

- standard BNEN title page (see BNEN website, Thesis section)
- copyright message (see Section 4.3)
- signed standard thesis abstract page (see BNEN website, Thesis section)
- preface/acknowledgements
- two page summary in Dutch or in French, depending on the respective university enrolment
- list of used symbols

- list of used abbreviations
- table of contents
- introduction
- body of the master thesis (several chapters)
- general conclusions !
- bibliography
- (appendices).

The master thesis text should be made on format DIN A4 with line spacing 1.5. It is typically a document of 60 to 100 pages (appendices not included).

4.3. Copyright message

The students, promoters and mentors should discuss the content of the copyright message. An example of a copyright message is:

All property right and copy right are reserved. Any communication or reproduction of this document and any communication or use of its contents without explicit authorisation is prohibited. Any infringement to this rule is illegal and entitles to claim damages from the infringer, without prejudice to any other right in case of granting a patent of registration in the field or intellectual property.

© BNEN, Belgian Nuclear higher Education Network¹

4.4. Electronic version

The electronic version of the outcome of the master thesis project should be distributed to all member of the thesis examination committee and to the BNEN secretariat. The electronic version contains at least the final master thesis text in pdf-format and the abstract/information page. It could further include:

- the source code of the final master thesis text (Word, LateX, ...), including figures;
- used data files;
- input files of computer programmes used;
- code written in Fortran, C, ... ;

¹ BNEN is a consortium of the Belgian universities KU Leuven, Université catholique de Louvain (UCL), Université de Liège (ULg), Universiteit Gent (UGent), Vrije Universiteit Brussel (VUB), Université Libre de Bruxelles (ULB) in collaboration with the Belgian Nuclear Research Centre SCK•CEN.

Administration Manager BNEN: Nele Kesteloot c/o SCK•CEN, Boeretang 200, B-2400 MOL, Belgium.

- the final thesis presentation.

4.5. Confidentiality

A number of copies of the master thesis text will end up in the libraries of the partner institutions of the BNEN. Obviously these copies should not contain confidential information. That is why students should **discuss confidentiality with the company or research institute** where the master research is pursued and with the promoter(s) and mentor(s).

If confidentiality is an issue, students will have to make a confidential and a non-confidential version of their final master thesis text. The confidential version should clearly mention the word "CONFIDENTIAL" on the title page.

The non-confidential version should not contain confidential information or this information should be presented in such a form (e.g. by omitting units or exact numerical values) that it can be made public without breaching the confidentiality. The confidential information can also be made anonymous by not giving the name of the company or any other information that reveals the company's name. In this last case, be careful in writing the acknowledgements of the non-confidential version, to avoid that you accidentally reveal the identity of staff members.

The non-confidential version of a thesis text should be self-contained and well readable too.

If a confidential version has to be made, the students give a confidential to the promoter(s) and mentor(s), and a non-confidential copy to the assessors. They submit a confidential and a non-confidential copy to the BNEN secretariat.

5. Master thesis paper

5.1. General principles

Students can choose to submit a publishable paper, instead of a classical master thesis text, to the thesis examination committee, which will act as a pre-review committee deciding whether the paper is suitable for submitting for publication.

Not every master thesis research can lead to a publishable paper. The thesis subject should be a **genuine scientific research project with an innovative character**. Students should discuss with their promoter and mentor whether or not their thesis subject is suitable for writing a paper.

Writing a *publishable* paper means that the paper **must actually be submitted** for publication to a **international scientific journal with review** after the thesis examination committee approves the paper (a score of 11/20 or more). The thesis examination committee can ask the student to make some final changes before submitting the paper.

Before submitting the paper to the thesis examination committee, students, promoters and mentors should discuss to which scientific journal(s) they will submit the paper.

The graduation of students who, after being approved by the thesis examination committee, fail to submit their paper for publication can be postponed.

The graduation of the students will not depend on whether, or not, the paper is finally accepted or rejected by the scientific journal. The thesis examination committee must nevertheless only approve papers which have a real chance of being accepted. The promoter of the master thesis project will inform the Steering Committee whether or not the submitted paper is finally accepted or not by the scientific journal(s).

5.2. Content

The size of a paper is considerably smaller (10-20 pages) than the size of a classical master thesis text (60 to 80 pages), but this is compensated by the fact that the subject is treated in a profound way.

The master thesis text should be a maximum of 60 – 80 pages (+ appendices).

Before starting to write a thesis paper, students should **make a detailed outline** and discuss it with the mentor(s).

Scientific journals demand that the quality of the English used is very high (native-equivalent). This is therefore also expected from the thesis paper.

In writing a master thesis paper, students should follow the *guidelines for authors* of the journal to which they will submit their paper. Students should attach a copy of these guidelines when submitting the paper to the thesis examination committee.

In this case, the final master thesis text, contains the following parts:

- standard BNEN title page (see BNEN website, Thesis section)
- copyright message (see Section 4.3)
- signed standard thesis abstract page (see BNEN website, Thesis section)
- preface/acknowledgements

- two page summary in Dutch or in French, depending on the respective university of enrolment
- paper as it will be submitted to the scientific journal
- appendix with the guidelines for authors of the scientific journal.

5.3. Electronic version

See Section 4.4.

6. All's well that ends well

6.1. Submitting

Students are not allowed to defend their master thesis before the promoter has signed the thesis abstract page (see BNEN website, Thesis section). For this purpose, a preliminary version of the thesis must be made available to the promoter 4 weeks before the presentation at the latest. This preliminary version should not be a rough electronic draft but a complete paper version with pictures, references, etc. It goes without saying that, at least in parallel, but better on beforehand, the preliminary thesis version is submitted to the mentor.

Once the thesis work has been approved for defence by the promotor, a complete paper version of the thesis report must be made available to all jury members 2 weeks before the presentation at the latest.

At the day of the defence, the students should provide the BNEN secretariat with one paper copy and the electronic version of the master thesis text.

If students have done their master thesis research in collaboration with a company or a research institute, they should make an agreement with them about the number of thesis copies they have to deliver.

Students considering to submit their thesis to "master thesis contests" probably must print additional copies.

The graduation of students who do not submit the right number of thesis copies or the electronic version of the master thesis can be postponed.

6.2. Thesis summary page

Students are asked to submit a standard thesis summary or abstract page, see BNEN website, Thesis section, together with their final thesis text. This page contains a **short** (maximum 15 lines) **publishable abstract** with the **main objectives and conclusions** of the master thesis project.

6.3. Final master thesis presentation

After the completion of the final thesis text, the students orally present the main results and conclusions of their thesis work to the promoter(s), mentor(s) and assessors. In consultation with the mentor or promoter, other people can attend the meeting.

The duration of this presentation is 25 minutes. After this presentation the members of the thesis examination committee and the other members of the audience have the possibility to ask questions about the thesis presentation and the final thesis text.

This presentation should be self-contained so that everyone with a general nuclear engineering background should be able to understand the gist of the master thesis project without having to read the final thesis text.

The quality of this presentation will be taken into account in the final evaluation of the master thesis project.

7. European Master of Science in Nuclear Engineering

Students might consider to do their project work or thesis abroad in the framework of the European Nuclear Education Network (ENEN) to qualify for the European Master of Science in Nuclear Engineering certification. For more information, contact the BNEN secretariat or any of the BNEN professors.

The European Master of Science in Nuclear Engineering (EMSNE) is a Certificate delivered by the European Nuclear Education Network Association, with the endorsement of all its members, in order to certify the highest quality standards of Nuclear Engineering Education and the European dimension pursued achieved by the EMSNE laureate.

Summary of the requirements:

- At least 5 years university education (3+2, 4+1, or 5);
- At least 60 ECTS must be "purely nuclear";

- 20 ECTS must be obtained from a “foreign” (different country) institution, member of the ENEN Association;
- Master thesis.

8. Further guidelines

8.1. Administrative guidelines

Students do not only have to take into account the guidelines of the BNEN, but also check possible additional thesis guidelines set by the university of registration, such as:

- additional master thesis copies for the university library;
- additional abstracts in the language of the university (French, Dutch);
- ...

The mentor or promoter of the university of registration will help the students with checking possible additional requirements.

8.2. Writing in English

The following books can help you to write a scientific master thesis text in English:

- John M. Swales and Christine B. Feak, *Academic Writing for Graduate Students, A Course for Nonnative Speakers of English*, The University of Michigan Press, Ann Arbor, 2001.
- H.F Ebel, C. Bliefert & W.E. Russey, *The Art of Scientific Writing*. Second completely revised edition. Weinheim: Wiley-VCH Verlag, 2003.
- N. J. Higham. *Handbook of Writing for Mathematical Sciences*. SIAM, 1998.

The following references could be useful to consult during the preparation of your presentations:

- Matt Carter, *Designing Science Presentations. A visual guide to figures, papers, slides, posters and more*, Amsterdam: Elsevier, 2013.
- Martha Davis, K. Davis & M. Dunagan, *Scientific Papers and Presentations*. Third edition. Amsterdam: Elsevier, 2013.

8.3. Tips and tricks

Make sure that every report you write clearly shows that it is a master thesis report and indicate the date, title, author, distribution list.

Use a notebook and not loose sheets to write down results or meeting notes. It will help not to lose information.

Choose concise and revealing titles for the chapters and subchapters. Listed in the table of contents, these titles should, on their own, indicate the structure of the master thesis text.

Start every chapter of the thesis text body with a short introduction and end with a short conclusion. It will help the reader to keep track of the structure of the master thesis.

People can be a bit sensitive about (not) being mentioned in the acknowledgements. 😊 Therefore, do not mention too many persons in your preface/acknowledgements, since you will probably forget someone. On the other hand, do not forget the promoters and mentors and the staff of the company or research institute where the master thesis research was done.

The most important (and most read) parts of your master thesis text are the introduction and the general conclusions. They should not be hastily written just before submitting the final thesis text, on the contrary, take extra care in writing them. Make sure that they are self-contained and that they invite the reader to read the whole thesis text. Do not stick to words, a couple of revealing quantitative results in your (general) conclusions will strengthen the claims made.

Scientific research is never finished, therefore write some suggestions for further research in the general conclusions.

Good luck!