Implementation of International Nuclear Management Academy Master’s Program at NRNU MEPhI

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Abstract. The International Nuclear Management Academy (INMA) is an IAEA facilitated collaboration framework in which universities provide master’s degree programmes focusing on the management aspect for the nuclear sector. The INMA targets current and future managers working in the nuclear energy and nuclear non-power application sectors. The purpose of the INMA is to improve the safety, performance and economics of nuclear technologies by promoting and enabling the availability and accessibility of consistent high quality educational opportunities for nuclear sector managers and improving their management competencies. The paper presents experience of implementation of INMA Master’s Program at the National Research Nuclear University MEPhI.

1. Introduction

The development of any national nuclear energy programme is dependent on the successful development of qualified human resources, through a sustainable nuclear educational and training programme supported by government and industry. Among the broad range of specialists needed for the continued safe and economic utilization of all nuclear technologies for peaceful purposes, competent nuclear managers are a vital component of any nuclear workforce [1, 2].

There are currently few master’s degree programmes specializing in management for the nuclear sector. University master’s programmes of business administration, technology management and public administration provide extensive and excellent courses in management, but few of them offer programmes that are specifically applicable to the nuclear sector. Some existing university departments of nuclear engineering provide courses related to management, but the number of such departments and courses is limited [3].

Engineers at nuclear power plants or other nuclear organizations have limited opportunities for obtaining formal management education. Likewise, many managers in the nuclear sector do not have a major in a nuclear-related technical degree programme and typically have few chances of obtaining such formal nuclear engineering/science education. In many developing countries, particularly those considering or in the process of launching nuclear energy programmes or those utilizing nuclear non-power applications, there is a lack of both technical and managerial experience in management and leadership roles [4, 5].
However, effective management and decision-making are critical throughout the nuclear technology life cycle in order to achieve and maintain high-levels of safety and performance. Management competencies need to be acquired not only by practical industry-focused training courses and on-the-job learning but also by formal education focused on theory, concepts and academic exercises [6].

Nuclear sector professionals who will move into managerial positions in the future, or those who are already managers, whether in developed or in developing countries, are expected to acquire appropriate competencies for their positions and this requires both nuclear technology related and managerial competencies. Further, in-house training is very costly and may not be as comprehensive as desired. Ideally, managers in the nuclear sector should acquire most of the necessary competencies before they move into managerial positions and complete their learning at least soon thereafter.

Thus, both nuclear regulators and licensed nuclear organizations recognize the need, interest and benefits of establishing formal educational programmes at the master’s level to meet this purpose. Further, such programmes need to be of high and consistent quality, to be tailored to address the specifics of the nuclear sector, and to be available part-time and by distance learning or short-format, in order to be accessible to busy nuclear professionals. Finally, they need to be available in English to support internationalization of the nuclear workforce and to meet the needs of developing countries [7].

2. Purpose of the INMA
The INMA is an IAEA facilitated collaboration framework in which universities and other educational institutions provide master’s degree programmes focusing on the management aspect for the nuclear sector. The INMA targets current and future managers working in the nuclear energy sector including power and non-power applications. The INMA will operate as a programme activity of the Nuclear Knowledge Management Section of the Department of Nuclear Energy of the IAEA.

INMA nuclear technology management (NTM) master’s degree programmes are intended to significantly benefit a Member State’s nuclear energy activities by helping to strengthen the competencies of nuclear managers. The NTM programmes equip managers with a broad understanding of the nuclear technology lifecycle and management best practices. Specific managerial knowledge such as nuclear safety, a global perspective, engineering economics, social regulations, public relations and ethical issues will prepare them to deal with risk informed decision making. The INMA-endorsed NTM programmes ensure the ongoing supply of highly qualified nuclear technology managers needed by nuclear energy sector employers including nuclear power plants, waste management facilities, R&D labs, regulatory bodies, technical support organizations, new build projects and nuclear energy related government ministries.

The purpose of the INMA is to improve safety, performance and economics of nuclear technologies by promoting and enabling the availability and accessibility of consistent high quality educational opportunities for nuclear sector managers and improving their management competencies through:

- Facilitating and supporting collaborations among nuclear engineering and science universities and other educational institutions in IAEA Member States to develop a framework for implementing and delivering master’s level education programmes in nuclear technology management for qualified students;
- Encouraging IAEA Member States to recognize the importance of nuclear management professionals in achieving and maintaining high-levels of safety and performance;
- Facilitating IAEA Member State and stakeholder involvement in establishing common requirements for nuclear technology managerial competencies and formal management education in response to the real needs of the nuclear sector;
- Providing peer review assessment of master’s level education programmes in nuclear technology management;
- Combining nuclear industry experience with formal academic education;
• Providing an e-learning platform to collect and share educational materials for nuclear management; and
• Encouraging and facilitating the availability and accessibility of high quality nuclear technology management programmes (in order to meet the needs of countries worldwide, including of developing country) through the various mechanisms, including university collaboration and resource sharing; e-learning; distance education; part-time programmes or short-format courses; and innovative use of technology.

3. Collaboration Framework of the INMA
The IAEA supports collaboration among universities and other educational institutions in its Member States to develop a framework for implementing nuclear management programmes through the INMA initiative. Any university or other educational institution authorized by its government to confer a master's degree can develop a master’s degree programme in nuclear technology management that can be officially recognized as an “INMA Nuclear Technology Management Programme” (hereinafter referred to as “INMA-NTM Programme”), provided the Programme is in compliance with the requirements established by the INMA and successfully assessed through an INMA Peer Review Assessment Mission.

The role of the IAEA is to coordinate, in cooperation with the INMA Members and the stakeholders, the following steps:
• Development and maintenance of common requirements for INMA-NTM Programmes;
• Organization of INMA Peer Review Assessment Missions for the assessment of INMA-NTM Programmes;
• Contribution to improving the INMA framework, including the establishment of the INMA Steering Committee and the INMA Advisory Board;
• Coordinating an INMA Annual Meeting for INMA Members and candidates for INMA membership;
• Organizing an annual INMA Student Forum; and
• Establishing and maintaining tools/mechanisms to help facilitate INMA-NTM Programme implementation, such as the IAEA Cyber Learning Platform for Network Education and Training (CLP4NET), which allows to archive and share educational materials for nuclear education, including for INMA-NTM Programmes.

A university or other educational institution that wants to develop and implement an INMA-NTM Programme and/or wants to have access to an online platform, which is a part of the CLP4NET, has to exchange a Cooperation Agreement on the INMA with the IAEA. The Cooperation Agreement is established upon request to the IAEA through official channels by a university or other educational institution. Once both parties have approved the Cooperation Agreement, the partner organization automatically becomes an “INMA Associate Member”.

Once an INMA Associate Member has its NTM Programme successfully assessed through the INMA Peer Review process, the programme can be recognized by the IAEA as an official INMA-NTM Programme, after which the INMA Associate Member becomes an “IMMA Full Member”.

INMA Associate Members and INMA Full Members are called “INMA Members” collectively and both are invited to the INMA Annual Meeting.

The purposes of the Cooperation Agreement are for INMA Members to show their commitment to promote the development and implementation of the INMA and for the IAEA to show its commitment to support INMA Members by offering facilitation measures.

Any university or other educational institution authorized by its government to confer a master's degree is encouraged to become an INMA Member, especially if they have an existing master’s level education programme in nuclear engineering or science, and if they are seriously considering developing and implementing an INMA-NTM Programme.

4. The INMA NTM programme of the National Research Nuclear University MEPhI
The National Research Nuclear University MEPhI is a leading Russian university that augments its positions on the global educational and science scenes with a strong contribution on nuclear technologies sector. The NTM master’s programme was launched at the NRNU MEPhI in September 2016 as a result of a joint work of the business and technical departments and stakeholders from the industry.

The goal of the programme is to prepare masters with management and technical competencies for successful work in the sphere of state and corporate governance, international cooperation, engineering and reengineering of business processes in the field of advanced nuclear energy technologies following interests of the global business of Russian state corporation Rosatom and other organizations.

The programme offers a blended learning approach with a combination of distance learning and face-to-face lectures, tutorials and laboratory sessions, delivered by renowned academics and nuclear industry practitioners. On successful completion of the programme graduates are capable to undertake formal economic analysis and empirically test solutions to managerial problems and possess the technical skills needed to solve managerial problems in nuclear industry. Students are encouraged to assimilate the significant content of recent developments in nuclear technology, nuclear science, economics and management theory in their studies [8-10].

The curriculum can be represented (as shown in table 1) in two sections/modules: technical and economical provided respectively by technical and business departments. Distribution of learning hours among aspect groups at NRNU MEPhI is shown in figure 1.

Table 1. Scope of the MEPhI’s programme (number of ECTS, one ECTS = 36 learning hours).

| Technical module (22)                                           | Economical module (39)                                      |
|-----------------------------------------------------------------|-------------------------------------------------------------|
| T1. Nuclear Physics and Nuclear Reactors (4)                   | E1. Advanced Microeconomics (4)                             |
| T2. Nuclear Power Equipment (2)                                | E2. Advanced Macroeconomics (4)                             |
| T3. Monitoring and Control of NPP (2)                           | E3. Corporate Finance (3)                                   |
| T4. Radiation Impact on Human Body and Environment (3)         | E4. Management in Nuclear Industry (3)                      |
| T5. Nuclear Technologies (2)                                   | E5. Innovative Technology Marketing (2)                     |
| T6. Nuclear Knowledge Management (2)                           | E6. Strategic Management (4)                                |
| T7. International Nuclear Cooperation (2)                      | E7. Econometrics (2)                                        |
| T8. NPP Dynamics and Safety (3)                                | E8. Cross-cultural Corporate Management (2)                 |
| T9. Nuclear Fuel Cycle and Radiation Safety Fundamentals (3)   | E9. Risk Management & Insurance (3)                         |
| T10. International and Legal Aspects of Non-Proliferation (2)  | E10. Business Process Modelling and IT (4)                  |
| T11. Nuclear Materials Protection, Control and Accounting Fundamentals (2) | E11. Innovative Project Management (2)                     |

Course T8 or T9, course T10 or T11                              Courses E10 + E11 or only E12

Practical seminar (5), Research work (15), Internship (33), Master’s thesis (6)  
Total 120 ECTS, 4320 learning hours in 2 years
In December 2016, the NRNU MEPhI presented its NTM programme to the IAEA expert mission, which positively assessed the developed programme as an INMA-NTM programme in accordance with the requirements of the IAEA International Nuclear Management Academy. In 2017 the programme was recognized as “IAEA INMA endorsed” programme and the NRNU MEPhI became a full member of INMA.

In June 2018 the first 14 graduates successfully completed the NTM programme defending the dissertations (theses) on different aspects related to managerial solutions in nuclear energy and non-power applications.

5. Conclusion

The NRNU MEPhI NTM programme has been implemented by the Faculty of Business Informatics and Management of Complex Systems and the Institute of Nuclear Physics and Engineering. The goal of the programme is to prepare masters with management and technical competencies for successful work in the sphere of state and corporate governance, international cooperation, engineering and reengineering of business processes in the field of advanced nuclear energy technologies. The NRNU MEPhI is the first and currently the only university in the world where there are graduates of the NTM programme.

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