IAEA Nuclear Energy Series

No. NG-O

Nuclear Energy General Objectives

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IAEA NUCLEAR ENERGY SERIES PUBLICATIONS

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Under the terms of Articles III.A and VIII.C of its Statute, the IAEA is authorized to foster the exchange of scientific and technical information on the peaceful uses of atomic energy. The publications in the **IAEA Nuclear Energy Series** provide information in the areas of nuclear power, nuclear fuel cycle, radioactive waste management and decommissioning, and on general issues that are relevant to all of the above mentioned areas. The structure of the IAEA Nuclear Energy Series comprises three levels: **1 — Basic Principles and Objectives; 2 — Guides; and 3 — Technical Reports.**

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NUCLEAR ENERGY GENERAL OBJECTIVES

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

IAEA NUCLEAR ENERGY SERIES No. NG-O

NUCLEAR ENERGY GENERAL OBJECTIVES

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Marketing and Sales Unit, Publishing Section
International Atomic Energy Agency
Vienna International Centre
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FOREWORD

One of the IAEA's statutory objectives is to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world". One way it achieves this objective is to issue publications in various series. Two of these series are the IAEA Nuclear Energy Series and the IAEA Safety Standards Series.

According to Article III, paragraph A.6, of the IAEA Statute, the IAEA safety standards establish "standards of safety for protection of health and minimization of danger to life and property." The safety standards include the Safety Fundamentals, Safety Requirements and Safety Guides. These standards are primarily written in a regulatory style, and are binding on the IAEA for its own activities. The principal users are Member State regulatory bodies and other national authorities.

The IAEA Nuclear Energy Series consists of reports designed to encourage and assist research on, and development and practical application of, nuclear energy for peaceful uses. This includes practical examples to be used by owners and operators of utilities in Member States, implementing organizations, academia and politicians, among others. The information is presented in guides, reports on the status of technology and advances, and best practices for peaceful uses of nuclear energy based on inputs from international experts. The series complements the IAEA's safety standards, and provides detailed guidance, experience, good practices and examples on the five areas covered in the IAEA Nuclear Energy Series.

The Nuclear Energy Basic Principles is the highest level publication in the IAEA Nuclear Energy Series and describes the rationale and vision for the peaceful uses of nuclear energy. It presents eight Basic Principles on which nuclear energy systems should be based to fulfil nuclear energy's potential to help meet growing global energy needs.

The Nuclear Energy Series Objectives are the second level publications. They describe what needs to be considered and the specific goals to be achieved at different stages of implementation, all of which are consistent with the Basic Principles. The four Objectives publications include Nuclear General Objectives, Nuclear Power Objectives, Nuclear Fuel Cycle Objectives, and Radioactive Waste Management and Decommissioning Objectives.

All four Objectives publications follow the same structure. For each topic in the area, the objectives are described in accordance with the sequence in the Basic Principles publication. Within each of these four Objectives publications, the individual topics that make up each area are addressed. The topics included in Nuclear General Objectives are Energy Systems Analysis and Development of Strategies for Nuclear Energy, Economics, Infrastructure, Management Systems,

Human Resources and Knowledge Management. The diversity of the topics contained in Nuclear General Objectives necessitated incorporating some repetition in order to simplify access to the relevant information for the various interested audiences.

The IAEA officers responsible for this publication were T. Mazour and P. Vincze of the Department of Nuclear Energy.

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1. INTRODUCTION

1.1. BACKGROUND

The IAEA's Nuclear Energy Basic Principles publication [1] presents the basic principles on which nuclear energy systems should be based to fulfil nuclear energy's potential to help meet growing global energy needs. The principles are intended to provide a broad and holistic approach to the use of nuclear energy, and to be equally applicable to all essential elements of nuclear energy systems, including human, technical, management and economic aspects, with due regard to the protection of people and the environment, non-proliferation and security.

The following paragraphs present an overview of the Basic Principles.

Beneficial use

— **Benefits.** The use of nuclear energy should provide benefits that outweigh the associated costs and risks.
— **Transparency.** The use of nuclear energy should be based on open and transparent communication of all its facets.

Responsible use

— **Protection of people and the environment.** The use of nuclear energy should be such that people and the environment are protected in compliance with the IAEA safety standards and other internationally recognized standards.
— **Security.** The use of nuclear energy should take due account of the risk of the malicious use of nuclear and other radioactive material.
— **Non-proliferation.** The use of nuclear energy should take due account of the risk of the proliferation of nuclear weapons.
— **Long term commitment.** The use of nuclear energy should be based on a long term commitment.

Sustainable use

— **Resource efficiency.** The use of nuclear energy should be efficient in using resources.
— **Continual improvement.** The use of nuclear energy should be such that it pursues advances in technology and engineering to continually improve

safety, security, economics, proliferation resistance, and protection of the environment.

1.2. PURPOSE AND SCOPE

This publication establishes the objectives that need to be considered and the specific goals to be achieved by the Member States in order to be consistent with the Nuclear Energy Basic Principles in the area of general nuclear issues, which include the following topics:

— Energy systems analysis and development of strategies for nuclear energy;
— Economics;
— Infrastructure;
— Management systems;
— Human resources;
— Knowledge management.

These six areas are collectively known as 'Nuclear General'.

1.3. DERIVATION OF THE NUCLEAR GENERAL OBJECTIVES

The Nuclear General Objectives reflect the goals and needs of Member States for long term energy strategies that ensure efficiency, safety and cost benefits, and are adequately managed and maintained for the lifetime[1] of the facility. The objectives for all topics were developed through collaboration with and advice from participants and Member States in multiple technical meetings, committee meetings and conventions.

[1] Lifetime in this context is used as in Ref. [6], and includes all activities, from pre-siting to decommissioning and waste management.

2. DESCRIPTION OF THE NUCLEAR GENERAL OBJECTIVES

The objectives for each topic within the area of 'Nuclear General' are described in accordance with the sequence in the Basic Principles publication [1].

2.1. OBJECTIVES FOR ENERGY SYSTEMS ANALYSIS AND DEVELOPMENT OF STRATEGIES FOR NUCLEAR ENERGY

Basic Principle: Benefits

Objective: *The energy systems analysis and the development of strategies for nuclear energy consider the options which lead to a system that delivers affordable, secure and clean energy services; and that the potential of nuclear energy for meeting future energy needs is analysed with its specific characteristics and requirements for technological and institutional development.*

The energy systems analysis will ensure that: (a) the evaluation of energy options is holistic and integrated, covering social, economic and environmental aspects; (b) the energy strategies strive to deliver affordable, secure and clean energy services; (c) the contribution of nuclear energy to meeting future energy needs is analysed with its specific characteristics and requirements for technological and institutional development; and (d) nuclear energy contributes to the sustainable development goals of the Member States [2–5].

Basic Principle: Transparency

Objective: *The energy systems analysis and the development of strategies for nuclear energy are presented and discussed in an open and transparent manner, engaging stakeholders and the public, by organizations in the nuclear field.*

The energy systems analysis will ensure that: (a) the information is shared with all stakeholders (i.e. relevant governmental departments, utilities, research institutes, regulatory authorities and the public); and (b) the concerns of stakeholders are appropriately addressed. This calls for the appropriate disclosure of assumptions, including security, safeguards, technical and financial, and the methodology underlying the assessments and analysis [2–5].

Basic Principle: Protection of people and the environment

Objective: *The energy systems analysis and the development of strategies for nuclear energy of the Member States give credit for strengthening and achieving higher levels of protection of the public and the environment from adverse impacts of energy conversion and use.*

The assessment of energy options and nuclear energy systems will include the potential assessment of impacts on the public and the environment; and the strategies for the development of energy systems and nuclear energy technologies will explicitly include continuous striving to achieve higher safety, mitigate potential adverse environmental impacts and reduce waste generation [2–5].

Basic Principle: Security

Objective: *The energy systems analysis and the development of strategies for nuclear energy address security concerns relating to different energy options and includes in the analysis necessary improvements in technical, regulatory and institutional areas.*

The energy system analysis will address potential security concerns relating to different energy options and also identify the necessary improvements to procedures and practices in technical, regulatory and institutional areas [2–5].

Basic Principle: Non-proliferation

Objective: *The energy systems analysis and the development of strategies for nuclear energy include the assessment of proliferation concerns and non-proliferation benefits.*

The energy systems analysis for the development of nuclear energy strategies will include the assessment of proliferation concerns, safeguards arrangements, the study of relevant information and necessary innovation relating to reactor technologies and fuel cycle options, and relevant institutional arrangements to improve the proliferation resistance of the nuclear energy system in order to fulfil national obligations in relation to non-proliferation of nuclear weapons [2–5].

Basic Principle: Long term commitment

Objective: *The energy systems analysis and the development of strategies for nuclear energy include the evaluation of technical, economic, institutional and regulatory requirements and commitments on a long term basis, and covering the entire fuel cycle.*

As most energy production, conversion, waste management and supply facilities have very long operating lifetimes, which include decommissioning and waste management after facility shutdown, the energy systems analysis will ensure that the assessment of energy options and nuclear energy systems includes the evaluation of technical, economic, institutional and regulatory requirements and commitments on a long term basis [2–5].

Basic Principle: Resource efficiency

Objective: *The energy systems analysis and the development of strategies for nuclear energy include the assessment of the efficiency of resource use, and the identification of technical innovations to improve the efficiency of resource use.*

Energy services are delivered using natural resources, employing various technologies and devoting personnel to the system. The energy systems analysis will ensure that the assessment of energy options and nuclear energy systems includes both assessment of the efficiency of resource use and the identification of technical innovations to continue to improve the efficiency of resource use [2–5].

Basic Principle: Continual improvement

Objective: *The energy systems analysis and the development of strategies for nuclear energy provide for the continual improvement of the sustainability of energy services in terms of safety, affordability, reliability, security and environmental compatibility.*

The energy systems analysis will ensure that the energy strategies strive for continual improvement of the sustainability of energy services in terms of affordability, reliability, safety, security and environmental compatibility. Sharing good practices, experience and information on technical, institutional and regulatory improvements and innovations is encouraged. International cooperation and collaboration provides an efficient means for this purpose [2–5].

2.2. OBJECTIVES FOR ECONOMICS

Basic Principle: Benefits

Objective: *The economic analysis and evaluation of nuclear energy compare the alternatives that cover the social costs and benefits on a lifetime basis, as well as the commercial and financial viability of nuclear energy projects.*

The economic analysis of nuclear and non-nuclear energy supply options will cover not only the direct economic costs and benefits, but also the long term investment, uncertainties in energy supplies and costs, as well as appropriate external costs and environmental factors such as reduction of effluent gas emissions. The economic competitiveness and consideration of indirect costs of nuclear energy will be established with respect to the commercial and financial viability of nuclear energy project(s) in direct comparison with non-nuclear alternatives, over the expected lifetime(s) of the energy project(s) [4].

Basic Principle: Transparency

Objective: *The economic assessment of nuclear energy is conducted in an open and transparent manner with results reported to the public.*

The economic assessment of nuclear energy versus non-nuclear energy supply options will be transparent and will allow for full involvement of stakeholders. Avenues of communication for reporting to and receiving input from stakeholders will be established. The assumptions and methodologies of analysis will be clearly reported so that other entities can repeat, or challenge, the assessments [4].

Basic Principle: Protection of people and the environment

Objective: *The economic assessment of nuclear energy includes the costs associated with the protection of people and the environment.*

The economic assessment of nuclear energy and other options will include the assessment of impacts on the public and the environment, the actual and potential adverse impacts, and the estimation of corresponding damage and other external costs. The possible prevention and mitigation solutions will be identified together with cost estimates for implementing those solutions. Appropriate strategies will be developed to minimize the adverse impacts of the energy systems on people and the environment [4].

Basic Principle: Security

Objective: *The economic assessment of nuclear energy includes the costs associated with ensuring nuclear security.*

The economic assessment will include the cost of measures for addressing security concerns relating to nuclear energy and other options. The costs relating to necessary improvements to procedures and practices from a technical and policy viewpoint, with all regulatory and institutional aspects, will be estimated and included in the economic assessments [4].

Basic Principle: Non-proliferation

Objective: *The economic assessment of nuclear energy includes the costs associated with preventing the proliferation of nuclear weapon technologies.*

The economic assessment will include the cost of measures for developing, improving, and implementing appropriate safeguards measures to fulfil national safeguard obligations, addressing concerns about the non-proliferation of nuclear weapon technologies and adherence to non-proliferation regimes. An economic evaluation of different strategies for developing and introducing proliferation resistant nuclear reactor technologies and fuel cycle options should be conducted [4].

Basic Principle: Long term commitment

Objective: *The economic assessment of nuclear energy includes the costs associated with the entire lifetime of the nuclear facilities, including decommissioning and waste disposal.*

As nuclear power plants involve very long term responsibilities and commitment (e.g. for decommissioning and waste disposal) beyond the commercial lives of the plants, the economic burden of those responsibilities and commitments will be assessed and included in the economic assessment, as well as the costs related to regulatory requirements and commitments on a long term basis [2–4].

Basic Principle: Resource efficiency

Objective: *The economic assessment of nuclear energy fully takes into account the use of natural and economic resources.*

The economic assessment of nuclear energy and other options will include the costs/depletion costs for natural resources, the use costs for economic resources (the opportunity cost of diverting financial resources to capital intensive projects), human resource development costs, and other resource use costs [3, 4].

Basic Principle: Continual improvement

Objective: *Nuclear energy systems strive for continuous improvement regarding economics and safety.*

The commercial and regulatory requirements must be balanced and a synergy developed between economics and safety. Safe plants perform better economically in the long run. The costs relating to improvements will be assessed and least cost, optimal solutions to achieve the desired, targeted or required safety level or standard will be developed and implemented. Sharing of good practices, experience and information on technical, institutional and regulatory improvements and innovations is encouraged.

2.3. OBJECTIVES FOR INFRASTRUCTURE

Basic Principle: Benefits

Objective: *National infrastructure for nuclear energy systems supports effective economical, safe, and secure implementation and operation, in a manner that provides societal benefits at an affordable cost, and with minimal and acceptable risks.*

From the initial consideration of nuclear energy systems, a structured, systematic approach will be taken to ensure that the costs and risks of the programme are acceptable and that the expected benefits to society are achieved [6–8].

Basic Principle: Transparency

Objective: *Infrastructure development for nuclear energy systems is done in a manner that provides openness and transparency, and acceptance by the public.*

Mechanisms will be established from the point of consideration of a nuclear power programme onwards to permit the appropriate involvement of stakeholders, including the public, in decision making processes [6–8].

Basic Principle: Protection of people and the environment

Objective: *Development of infrastructure for nuclear energy systems includes legal and regulatory arrangements and competencies necessary to protect people and the environment, consistent with the IAEA safety standards.*

The IAEA safety standards related to the protection of people and the environment, and their appropriate implementation as national laws and regulations will be addressed from the beginning of a nuclear power programme as a fundamental part of the infrastructure [6–8].

Basic Principle: Security

Objective: *Development of infrastructure for nuclear energy systems includes provisions for suitable protection against theft or malevolent acts.*

The IAEA's publications on nuclear security and their implementation as national laws and regulations will be considered from the beginning of a nuclear power programme as a fundamental part of the infrastructure.

Basic Principle: Non-proliferation

Objective: *Infrastructure development for nuclear energy systems includes provisions to prevent the proliferation of nuclear weapon technologies.*

Legally binding international requirements for the non-proliferation of nuclear weapon technologies, and their implementation in national laws and regulations should be considered from the beginning of a nuclear power programme as a fundamental part of the infrastructure.

Basic Principle: Long term commitment

Objective: *Development of infrastructure for nuclear energy systems is done with consideration of the entire lifetime of nuclear facilities, including suitable decommissioning and waste disposal plans.*

All elements of infrastructure will be assessed from initial considerations onward as to how they can be maintained for the long term, including decommissioning and suitable disposal of waste [2–4, 6–8].

Basic Principle: Resource efficiency

Objective: *Infrastructure development for nuclear energy systems includes the optimal use of resources for the implementation of nuclear technologies.*

Resource efficiency will be assessed across all components of the infrastructure, in support of a nuclear energy programme [6].

Basic Principle: Continual improvement

Objective: *Develop nuclear energy systems in such a manner as to continually improve the infrastructure, taking into account lessons learned both nationally and internationally.*

The nuclear field is unique in that 'an accident anywhere is an accident everywhere'. Thus, there is an incentive for freely and voluntarily sharing the means to improve within the field. This is particularly important for 'newcomer' States in the nuclear field, so that they can learn from relevant international experience. International cooperation and collaboration provides an efficient means for this purpose [9].

2.4. OBJECTIVES FOR MANAGEMENT SYSTEMS

Basic Principle: Benefits

Objective: *Organizations in the nuclear field establish and implement a management system, which includes the arrangements and processes necessary to achieve all the goals of the organization in a cost effective and integrated manner.*

The management system will be aligned with all the goals of the organization and incorporate all the requirements for managing the organization in a coherent manner within one integrated management system. The management system will ensure that a strong organizational culture, including safety culture, exists and is maintained. This set of interrelated and interacting

elements will aid in the establishment of policies and objectives, and enable those objectives to be achieved in a safe, efficient and effective manner [9, 10].

Basic Principle: Transparency

Objective: *The management system considers the expectations of interested parties and the system is implemented in such a way as to foster a culture of openness and transparency at all levels in the organization.*

The implementation of the management system includes the establishment of values, norms and processes that will ensure open and transparent communication with all interested parties. A proper implementation in these aspects is facilitated by good leadership capabilities at all levels in order to develop a sustainable culture that will promote openness and transparency [9].

Basic Principle: Protection of people and the environment

Objective: *The management system is designed to fulfil the requirements that must be met for the protection of people and the environment during all stages of the lifetime of nuclear energy systems.*

The management system will be consistent with the requirements established in the IAEA safety standards and other internationally recognized standards [7, 10].

Basic Principle: Security

Objective: *The management system is designed to fulfil all requirements that must be met for the security of nuclear energy systems in all stages of their lifetime.*

The management system will be designed and implemented in a way that fosters an awareness of and consideration for the security aspects of activities and systems in all the stages of the lifetime of nuclear energy systems.

Basic Principle: Non-proliferation

Objective: *The management system implements the arrangements needed for the accounting for and control of nuclear material, and ensures that all necessary arrangements are in place to comply with national safeguard obligations and are effectively fulfilled in a timely manner.*

The management system will be designed and implemented in a way that ensures respect for the procedures necessary to prevent the diversion of material for use in nuclear weapons [2].

Basic Principle: Long term commitment

Objective: *The management system recognizes and plans for the lifetime of nuclear technologies and their long term consequences.*

The establishment and implementation of the management system encourages strategic planning throughout the lifetime of nuclear energy systems [2–4].

Basic Principle: Resource efficiency

Objective: *The management system ensures effective resource planning and utilization throughout the entire lifetime of the use of nuclear technology.*

The integrated management system is based on the identification of the processes necessary to meet all requirements and implement the vision, goals, strategy and policies for achieving the objectives of the organization. Managing the processes of the organization efficiently is critical to its success and a key element is the identification of all necessary resources. An integrated approach should facilitate, through implemented, assessed and continually improved processes, the optimal use of the resources, including personnel, infrastructure, the working environment, information and knowledge, and suppliers, as well as material and financial resources [2].

Basic Principle: Continual improvement

Objective: *The management system systematically develops and implements plans for continual improvement.*

The management system will be reviewed at planned intervals to ensure its suitability and effectiveness, and to identify whether there is a need to make changes or improvements in the policies, goals, strategies, plans, objectives and processes of the organization. A learning culture will be fostered through proper leadership and the commitment of senior management through their personal involvement, sponsorship and prioritization of continual improvement [9].

2.5 OBJECTIVES FOR HUMAN RESOURCES

Basic Principle: Benefits

Objective: *Organizations in the nuclear energy field develop and maintain the highest levels of performance and competence of their personnel commensurate with the risks associated with nuclear technologies.*

Organizations in the nuclear energy field must pay greater attention to the planning, recruitment, selection, training, certification and development of their human resources than do many other industries. This is due to both the consequences of inadequate performance and the large investments of time and money necessary to develop the competences needed to perform to the high standards. Organizations will ensure that all employees are fully competent to undertake their respective roles to maintain the highest levels of performance [9].

Basic Principle: Transparency

Objective: *Public communication activities are organized in such a way as to provide openness and transparency in the use of nuclear technologies.*

While there are some limitations on the disclosure of information relating to non-proliferation and security, these are a relatively small part of the overall activities in the field of nuclear energy. Information regarding other aspects of nuclear facilities will be shared with affected stakeholders, both internal and external to the nuclear field, and with established avenues for communication. Appropriate staff will be trained to ensure effective communication with the public.

Basic Principle: Protection of people and the environment

Objective: *Organizations in the nuclear field ensure that personnel develop and maintain the competences needed to comply with the IAEA safety standards relating to the protection of people and the environment.*

The competences relating to the protection of people and the environment will be identified for all nuclear facilities and organizations, and suitable mechanisms put in place to ensure that all personnel assigned such tasks are competent to perform to the necessary standards [7, 10].

Basic Principle: Security

Objective: *Organizations in the nuclear field ensure that personnel develop and maintain the competences necessary to comply with national and IAEA guidelines related to nuclear security.*

The competences relating to nuclear security will be identified for all nuclear facilities and organizations, and suitable mechanisms put in place to ensure that all personnel assigned such tasks are competent to perform to the necessary standards.

Basic Principle: Non-proliferation

Objective: *Organizations in the nuclear field develop and maintain the human resources needed to plan and implement appropriate safeguard arrangements, in such a way as to prevent the proliferation of nuclear weapon technologies.*

The competences related to preventing the proliferation of nuclear weapon technologies will be identified for all nuclear facilities and organizations, and suitable mechanisms put in place to ensure that all personnel assigned such tasks are competent to perform to the necessary standards [2].

Basic Principle: Long term commitment

Objective: *Organizations in the nuclear field plan for their future staffing, competence and performance related needs for the lifetime of their nuclear facilities.*

The lifetime of nuclear facilities can be decades or more, from the consideration of the feasibility of a nuclear power programme to the final decommissioning of nuclear power plants. Waste disposal facilities are likely to be operated for over a century. Thus, a long term view and planning are necessary to ensure that adequately qualified personnel are provided for this entire lifetime [2–4, 9].

Basic Principle: Resource efficiency

Objective: *Organizations in the nuclear field organize their activities so as to make optimal use of resources for the implementation of nuclear technologies.*

Owing to the demanding and time consuming education, training, and qualification programmes needed for many positions in the nuclear field, it is important that these resources, including individual support and succession plans for the future, are maintained once they are developed.

Basic Principle: Continual improvement

Objective: *Organizations and individuals in the nuclear field continually strive to improve their performance.*

The effectiveness of education, training and other methods of development of human resources, as well as the effectiveness of the organizational structure, will be continually monitored and the results used to improve performance [9].

2.6. OBJECTIVES FOR KNOWLEDGE MANAGEMENT

Basic Principle: Benefits

Objective: *Nuclear knowledge management strategies are formulated, adopted and implemented at a level aimed at enhancing the benefits of nuclear power systems to society at large.*

Because nuclear energy is a high technology endeavour, it requires a solid scientific and technical knowledge base to provide energy to society in a clean and affordable way. In this respect a well formulated and focused knowledge management strategy, aimed at maximizing the return on intellectual and informational resources, can ensure that the full benefits from using nuclear energy are assured and maintained through succeeding workforce lifetimes [2, 9].

Basic Principle: Transparency

Objective: *Knowledge management programmes provide for the use of nuclear knowledge in a transparent way and also for its social acceptance.*

Knowledge management programmes in nuclear organizations will provide for a better understanding of the implications of nuclear activities on the part of society, as well as communicating the scientific and technical knowledge base of nuclear development [2, 9].

Basic Principle: Protection of people and the environment

Objective: *Dedicated knowledge management programmes are applied, which are aimed at enhancing the safety of nuclear installations and the protection of people and the environment.*

Safety is critical to the successful operation of nuclear power plants as well as other nuclear installations. Sustained management of knowledge and skills are necessary for achieving the highest possible level of safety and environmental protection [2, 7, 10].

Basic Principle: Security

Objective: *Knowledge management programmes are designed and implemented to exclude information thefts and other malicious acts affecting nuclear installations and materials, and with the aim of enhancing security.*

Proper knowledge management programmes and their application will provide for the stewardship of sensitive information and contribute to enhancing the security of nuclear installations [2, 9].

Basic Principle: Non-proliferation

Objective: *Knowledge management programmes identify and protect confidential and classified knowledge and information and ensure that their use is in accordance with international obligations in relation to the non-proliferation of nuclear weapons and ensures continuity of safeguards information.*

Knowledge management programmes will take into consideration all aspects of non-proliferation related issues in scientific research and development. While knowledge sharing is a stimulus for innovation and development, knowledge protection in some specific areas is also an important element of the overall knowledge management strategy [2].

Basic Principle: Long term commitment

Objective: *Knowledge management systems maximize the flow of nuclear knowledge from one generation to the next, and attract, maintain and further develop a dedicated body of highly competent professional staff, in order to sustain nuclear competence over the entire lifetime of nuclear installations.*

Implementing a nuclear energy programme is a long term commitment, involving repeated intergenerational transfer of accumulated knowledge and skills. This is achieved by means of a long term knowledge management strategy, which needs periodic updating [2–4, 9].

Basic Principle: Resource efficiency

Objective: *Nuclear knowledge is managed as a basic economic resource, and includes three fundamental components: personnel, processes and technology, for all stages of the nuclear fuel cycle.*

Like other resources, knowledge requires a systematic and integrated management system approach in order to achieve the most efficient use and expected results from its implementation. For this reason, the design and implementation of a nuclear knowledge management strategy will always be dependent on economic efficiency and the best use of intellectual capital in the nuclear field [2].

Basic Principle: Continual improvement

Objective: *Knowledge management is applied as a key driver for continuous improvement.*

Knowledge management is a component of the scientific and technological developments in the nuclear field. This knowledge will be used in a continual improvement strategy, and continuous improvement is a key element of any knowledge management strategy [2, 9].

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Annex

SUMMARY TABLE OF OBJECTIVES FOR EACH NUCLEAR ENERGY BASIC PRINCIPLE (BP)

BP	Energy system analysis and development of strategies for nuclear energy	Economics	Infrastructure	Management systems	Human resources	Knowledge management
1. BENEFITS	Energy systems analysis and development of strategies for nuclear energy consider options which lead to a system that delivers affordable, secure and clean energy services; and that the potential of nuclear energy for meeting future energy needs is analysed with its specific characteristics and requirements for technological and institutional development.	The economic analysis and evaluation of nuclear energy compare alternatives that cover the social costs and benefits on a lifetime basis, as well as the commercial and financial viability of nuclear energy projects.	National infrastructure for nuclear energy systems supports effective economical, safe, and secure implementation and operation, in a manner that provides societal benefits at an affordable cost and with minimal and acceptable risks.	Organizations in the nuclear field establish and implement a management system which includes the arrangements and processes necessary to achieve all the goals of the organization in a cost effective and integrated manner.	Organizations in the nuclear energy field develop and maintain the highest levels of performance and competence of their personnel commensurate with the risks associated with nuclear technologies	Nuclear knowledge management strategies are formulated, adopted and implemented at a level aimed at enhancing the benefits of nuclear power systems to society at large.
2. TRANSPARENCY	The energy systems analysis and development of strategies for nuclear energy are presented and discussed in an open and transparent manner, engaging stakeholders and the public, by organizations in the nuclear field.	The economic assessment of nuclear energy is conducted in an open and transparent manner, with results reported to the public.	Infrastructure development for nuclear energy systems is done in a manner that provides openness and transparency, and acceptance by the public.	The management system considers the expectations of interested parties and the system is implemented in such a way as to foster a culture of openness and transparency at all levels in the organization.	Public communication activities are organized in such a way as to provide openness and transparency in the use of nuclear technologies.	Knowledge management programmes provide for the use of nuclear knowledge in a transparent way and also for its social acceptance.

BP	Energy system analysis and development of strategies for nuclear energy	Economics	Infrastructure	Management systems	Human resources	Knowledge management
3. PROTECTION OF PEOPLE AND THE ENVIRONMENT	The energy systems analysis and development of strategies for nuclear energy of the Member States give credit for strengthening and achieving higher levels of protection of the public and the environment from adverse impacts of energy conversion and use.	The economic assessment of nuclear energy includes the costs associated with the protection of people and the environment.	Development of infrastructure for nuclear energy systems includes legal and regulatory arrangements and competencies necessary to protect people and the environment, consistent with the IAEA Safety Standards	The management system is designed to fulfil the requirements that must be met for the protection of people and the environment during all stages of the lifetime of nuclear energy systems.	Organizations in the nuclear field ensure that the personnel develop and maintain the competences needed to comply with the IAEA Safety Standards relating to the protection of people and the environment.	Dedicated knowledge management programmes are applied, which are aimed at enhancing the safety of nuclear installations and the protection of people and the environment.
4. SECURITY	The energy systems analysis and development of strategies for nuclear energy address security concerns relating to different energy options and includes in the analysis necessary improvements in technical, regulatory and institutional areas.	The economic assessment of nuclear energy includes the costs associated with ensuring nuclear security.	Development of the infrastructure for nuclear energy systems includes provisions for suitable protection against theft or malevolent acts.	The management system is designed to fulfil all requirements that must be met for the security of nuclear energy systems in all stages of their lifetime.	Organizations in the nuclear field ensure that the personnel develop and maintain the competences necessary to comply with national and IAEA guidelines related to nuclear security.	Knowledge management programmes are designed and implemented to exclude information thefts and other malicious acts affecting nuclear installations and materials, and with the aim of enhancing security.

BP	Energy system analysis and development of strategies for nuclear energy	Economics	Infrastructure	Management systems	Human resources	Knowledge management
5. NON-PROLIFERATION	The energy systems analysis and development of strategies for nuclear energy include the assessment of proliferation concerns and non-proliferation benefits.	The economic assessment of nuclear energy includes the costs associated with preventing the proliferation of nuclear weapon technologies.	Infrastructure development for nuclear energy systems includes provisions to prevent the proliferation of nuclear weapon technologies.	The management system implements the arrangements needed for the accounting for and control of nuclear material, ensures that all necessary arrangements are in place to comply with national safeguard obligations and are effectively fulfilled in a timely manner.	Organizations in the nuclear field develop and maintain the human resources needed to plan and implement appropriate safeguard arrangements, in such a way as to prevent the proliferation of nuclear weapon technologies.	Knowledge management programmes identify and protect confidential and classified knowledge and information, and ensure that their use is in accordance with international obligations in relation to the non-proliferation of nuclear weapons and ensures continuity of safeguards information.
6. LONG TERM COMMITMENT	The energy systems analysis and development of strategies for nuclear energy include the evaluation of technical, economic, institutional and regulatory requirements, and commitments on a long term basis and covering the entire fuel cycle.	The economic assessment of nuclear energy includes the costs associated with the entire lifetime of the nuclear facilities, including decommissioning and waste disposal.	Development of infrastructure for nuclear energy systems is done with consideration of the entire lifetime of nuclear facilities, including suitable decommissioning and waste disposal plans.	The management system recognizes and plans for the entire lifetime of nuclear technologies and their long term consequences.	Organizations in the nuclear field plan for their future staffing, competence and performance related needs for the complete lifetime of their nuclear facilities.	Knowledge management systems maximize the flow of nuclear knowledge from one generation to the next, and attract, maintain and further develop a dedicated body of highly competent professional staff, in order to sustain nuclear competence over the entire lifetime of nuclear installations.

BP	Energy system analysis and development of strategies for nuclear energy	Economics	Infrastructure	Management systems	Human resources	Knowledge management
7. RESOURCE EFFICIENCY	The energy systems analysis and development of strategies for nuclear energy include the assessment of the efficiency of resource use, and the identification of technical innovations to improve the efficiency of resource use.	The economic assessment of nuclear energy fully takes into account the use of natural and economic resources.	Infrastructure development for nuclear energy systems includes the optimal use of resources for the implementation of nuclear technologies.	The management system ensures effective resource planning and utilization throughout the entire lifetime of the use of nuclear technology.	Organizations in the nuclear field organize their activities so as to make optimal use of resources for the implementation of nuclear technologies.	Nuclear knowledge is managed as a basic economic resource, and includes three fundamental components: personnel, processes and technology, for all stages of the nuclear fuel cycle.
8. CONTINUAL IMPROVEMENT	The energy systems analysis and development of strategies for nuclear energy provide for the continual improvement of the sustainability of energy services in terms of safety, affordability, reliability, security and environmental compatibility.	Nuclear energy systems strive for continual improvement regarding economics and safety.	Develop nuclear energy systems in such a manner as to continually improve the infrastructure, taking into account lessons learned both nationally and internationally.	The management system systematically develops and implements plans for continual improvement.	Organizations and individuals in the nuclear field continually strive to improve their performance.	Knowledge management is applied as a key driver for continual improvement.

CONTRIBUTORS TO DRAFTING AND REVIEW

Beatty, R.	International Atomic Energy Agency
Dahlgren-Persson, K.	International Atomic Energy Agency
Gowin, P.	International Atomic Energy Agency
Jalal, A.	International Atomic Energy Agency
Li, X.	International Atomic Energy Agency
Mazour, T.	International Atomic Energy Agency
Vincze, P.	International Atomic Energy Agency
Yanev, Y.	International Atomic Energy Agency

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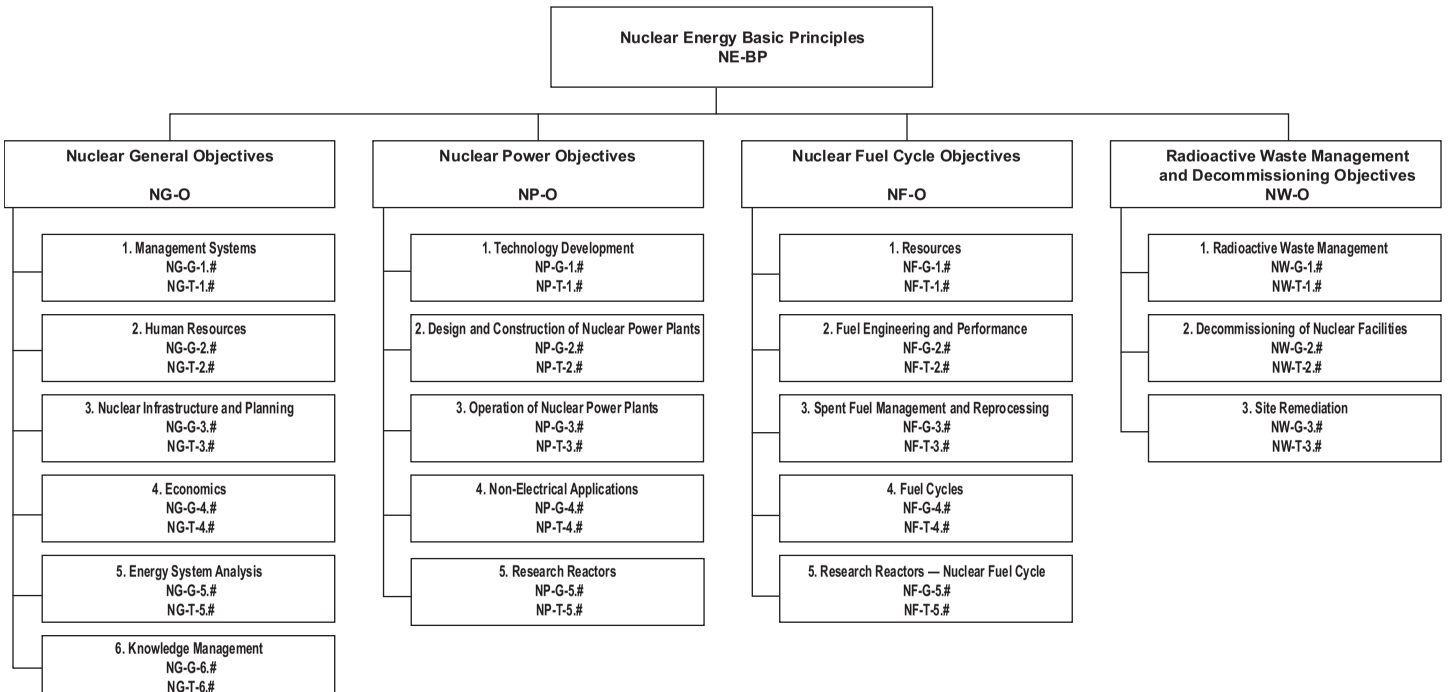

Key

BP: Basic Principles
O: Objectives
G: Guides
T: Technical Reports
Nos. 1-6: Topic designations
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