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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 this objective is achieved is through the publication of a range of technical series. Two of these are the IAEA Nuclear Energy Series and the IAEA Safety Standards Series.

According to Article III.A.6 of the IAEA Statute, the 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 written primarily in a regulatory style, and are binding on the IAEA for its own programmes. The principal users are the regulatory bodies in Member States and other national authorities.

The IAEA Nuclear Energy Series comprises reports designed to encourage and assist R&D on, and 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 government officials, among others. This information is presented in guides, reports on technology status and advances, and best practices for peaceful uses of nuclear energy based on inputs from international experts. The IAEA Nuclear Energy Series complements the IAEA Safety Standards Series.

The IAEA has outlined the need for research reactors (RRs) to have strategic plans (SPs) for their utilization, and, through a series of publications, has been encouraging facility managers, operators and stakeholders in this regard. The first publication, Strategic Planning for Research Reactors, was released as IAEA-TECDOC-1212 in 2001. In the meantime, planning the utilization and administration of RRs has changed according to how new technologies, business strategies and organizational structures have developed.

In order to reflect the current status and trends in RR utilization and management, a group of international experts under coordination of the IAEA reviewed 37 SPs submitted by RR managers in 2013–2014 from 30 Member States. Each SP was reviewed against the guidance of IAEA-TECDOC-1212. The resulting suggestions and recommendations of the experts were communicated to the originators of the SPs for their consideration.

As a follow-up to these SP reviews, the IAEA supported several meetings and workshops in 2013 and 2014 to facilitate the exchange of expert advice and local circumstances in order to improve the concept of RR SPs and their implementation. The outcomes of these meetings identified the need to revise IAEA-TECDOC-1212 and to publish a new version that will provide an improved approach to assist both existing and new RR operating organizations. The concrete examples and case studies from the SPs reviewed have also provided additional input and improvement to the revision of IAEA-TECDOC-1212.

The review of IAEA-TECDOC-1212 was also strongly recommended by the IAEA Technical Working Group on Research Reactors in 2014 and 2015. Although IAEA-TECDOC-1212 focused on enhancing the utilization of existing RRs, this revised version also provides guidance on how to develop an SP for a new RR and will be equally beneficial for organizations that are preparing a feasibility study to establish such a new facility.

This publication clearly explains that the long term sustainability of many RRs around the world depends upon the development and implementation of an effective and achievable SP for their optimized utilization. This publication aims to facilitate this process.

The IAEA wishes to acknowledge the assistance of all the experts who provided inputs and contributed to the revision of this publication, with particular thanks to C.S.B. Piani (South Africa) for final reviewing and editing. The IAEA officer responsible for this publication was D. Ridikas of the Division of Physical and Chemical Sciences.

CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

Strategic planning for research reactors (RRs) is a key process for ensuring the efficient, optimized and well managed utilization of both existing and newcomer RRs[1].

The key reason for preparing a strategic plan (SP) is that it provides a justification:

- For a new RR; or
- For continued safe and sustainable operation of an existing RR; and also
- For investments in modification and refurbishment of an existing RR.

Newcomer RRs benefit from an SP by justification of the project, by a broader understanding of their stakeholder needs and by clarified definition of the specification of the RR and its ancillary facilities in order to optimize its future utilization. On the other hand, existing RRs benefit by re-evaluation of stakeholder[2] needs in order to continue operation and to optimally increase utilization.

Irrespective of whether it is a new or existing facility[3], there may be a need for a change in mindset from the RR facility just ‘being available’ to taking control of the facility’s destiny by proactively seeking out new users and applications to ‘optimize its utilization’. Facility managers therefore need a straightforward and cost effective approach to both increasing utilization and efficiently managing the facility.

This publication shows that an SP is a useful tool and its preparation is a necessary step for these purposes. An SP provides a rationale for the future utilization of an RR facility, and preparing one is a worthwhile exercise for all such facilities, irrespective of mission, complexity, power or size. An SP should provide a framework for the continued operation of the RR, either by increasing utilization or ensuring optimized future utilization. At the same time, a well balanced SP should help to create a positive safety culture, a motivated staff, a clear understanding of real costs and a balanced budget. A well run RR facility also has the distinct advantage that it can contribute positively to national needs and socioeconomic development.

An SP is a document that is used to communicate organizational goals and actions needed to achieve those goals, and should be seen as an essential tool for good governance of any RR, from the smallest critical facility to the largest reactor. In fact, not only is it a document that can provide justification for the operational funding[4] required for the facility, it is also a powerful means of management control for activities relating to the facility.

It must be emphasized that the methodology for the preparation of an SP as identified in this publication is purely for guidance and is not mandatory, unless it is a specific requisite by the IAEA when evaluating requests for technical/financial assistance. The IAEA does not expect general publication of SPs or public disclosure of the information contained therein. The IAEA will prioritize support requests for new ancillary facilities or equipment for RR utilization if they are accompanied by an SP clearly demonstrating that the items requested are necessary to achieve the objectives of the plan.

The development of a (preliminary) SP for newcomer RRs is specifically addressed in the IAEA publication Specific Considerations and Milestones for a Research Reactor Project [1], and is part of a feasibility study. In particular, that publication addresses 19 relevant issues[5] according to the three phases of preparedness for an RR project, as indicated in Table 1.

[1] ‘Newcomer RRs’ refers to those that are the first of their kind in a country, as well as to those replacing or complementing existing RRs in a country, in particular, with much higher reactor power.

[2] ‘Stakeholders’ are defined as persons and/or institutions that have a direct or indirect interest, or involvement, in the operation and utilization of the facility. This should not be confused with ‘shareholders’, who have an investment interest in the facility.

[3] ‘Facility’, unless indicated otherwise, refers to the RR and its support and ancillary systems.

[4] Though opportunities for external funding might exist and have been demonstrated, it is generally not possible to make an RR facility fully self-sustainable from a financial point of view.

[5] The 19 relevant issues for RR development are: national position; nuclear safety; management; funding and financing; legislative framework; safeguards; regulatory framework; radiation protection; RR utilization; human resources development; stakeholder involvement; site survey, site selection and evaluation; environmental protection; emergency planning; nuclear security; nuclear fuel management; radioactive waste; industrial involvement; procurement.

TABLE 1. INFRASTRUCTURE DEVELOPMENT PHASES AND MILESTONES OF A RESEARCH REACTOR [1]

Phase	Description	Milestone
(1) Pre-project	Justification of the research reactor and considerations before a decision to launch a research reactor project is taken	Ready to make a knowledgeable commitment to a research reactor project
(2) Project formulation	Preparatory work for the construction of a research reactor after a policy decision has been taken	Ready to invite bids for the research reactor
(3) Implementation	Activities to design and construct a research reactor	Ready to commission and operate the research reactor

The importance of an SP is emphasized at the onset of the project (Phase 1), to help avoid problems with possible underutilization of the RR as it ages.

The production of an SP should therefore not be regarded as a time consuming academic exercise, but rather as an investment that will provide continuing benefits to the facility's upper management and decision makers. It should be recognized, however, that the application of an SP is an ongoing process that will require monitoring and regular updating to ensure success.

During the preparation of an SP, using the guidance given in this publication, each facility should apply good judgement to assess the applicability of the sections provided in the SP. Only then should the issues and questions that are appropriate to the facility be addressed, providing balanced detail in consultation with all relevant stakeholders.

The facility management should also ensure that the contributions to the various sections receive input from the responsible persons identified in the SP. Where possible, the final SP should be formally accepted by the facility's senior management (e.g. by a front page signature). This will ensure the accuracy of relevant information as well as adoption and ownership of the document by senior management.

The SP is a useful management document as well as a planning tool. It should therefore be regarded as a 'living document' to be reviewed and updated periodically, or when circumstances so dictate.

In those cases where the responsible authority feels that such advice or input is desirable, the draft SP should also be submitted to the IAEA for review and feedback, with support from external independent experts.

It should also be noted that some of the information included in an SP could be regarded as intellectual property or as commercially sensitive and intended for internal use only. It might thus be desirable to have different versions of an SP, for example, sufficiently filtered of sensitive information and suitable for general distribution or on-line publication.

In addition to the justifications expressed above, the development of an SP provides the following benefits for handling utilization requirements and sustainable operation:

— It provides a logical way to initiate and increase utilization of an existing or new RR.
— It enables applicable stakeholders to see the benefits and need for external support.
— It allows for appropriate additional fund raising for the facility.
— It can help to secure finances and justifies recruitment of staff and infrastructure upgrades.
— It communicates the priorities of a facility's management and could thereby demonstrate the importance of effectively implementing a safety, health, quality and environment culture.
— It is a means to effectively initiate and manage a change in personnel culture.

Examples of other drivers that might influence the need for preparation of an SP include:

— The loss of links to nuclear research, such as neutron beam experiments and/or training of students and other personnel;
— The loss of research or analytical groups complementary to the reactor that may have reduced the attractiveness of the facility;

— The ageing and imminent retirement of a number of experienced staff threatening the corporate knowledge of the facility;
— A decreasing utilization, including the loss of major reactor users, resulting in a significant percentage of time when the reactor is not operating;
— A major change in public or governmental support of nuclear facilities;
— A drive to reduce costs or, conversely, to increase funding in order to balance the budget or make up for reduced State support;
— Regulatory issues (e.g. changes in safety and security requirements);
— Liability issues (e.g. related to the back end of the fuel cycle and facility decommissioning);
— The desire to ensure continuous support by the IAEA;
— A major change in original focus of the facility (e.g. from research towards provision of irradiation products and services on a commercial basis, or from research towards education and training).

All of these can be addressed in a well deliberated SP. Alternatively, strategic planning could also be called upon if a facility were required to consider shutdown and decommissioning.

1.2. OBJECTIVE

The main objective of this publication is to contribute to the enhancement of the utilization of existing RRs and provide guidance on how to develop and implement an SP for a new RR project for organizations that are preparing a feasibility study to establish a new facility. It will enable RR management to determine the status of an existing reactor or the intended operation of a new facility. At the same time, management will be able to identify the capabilities of their RRs and match these to stakeholder/user needs and establish the feasibility of supplying such needs. Management could then also establish a long term vision that would not only accomplish optimized utilization of the RR but would also promote the sustainability of the reactor and its ancillary facilities.

Guidance provided here, describing good practices, represents expert opinion but does not constitute recommendations made on the basis of a consensus of Member States.

1.3. SCOPE

The original publication Strategic Planning for Research Reactors (IAEA-TECDOC-1212) [2] focused on enhancing the utilization of existing RRs, while this updated version also provides guidance on how to develop an SP for a new RR. It will therefore be of particular interest to organizations that are preparing a feasibility study to establish a new facility. This revision complements Specific Considerations and Milestones for a Research Reactor Project [1], and contributes to the important set of technical documents and guidelines for new RR facilities. In addition, the concepts contained in Applications of Research Reactors [3] are incorporated into this revision. Reference [3] brings together many of the current uses of RRs, and enables a reactor owner or operator to evaluate which applications might be possible with a particular RR facility, supporting research and development (R&D) programmes and/or providing products and services on a commercial basis.

1.4. STRUCTURE

This revised publication has been restructured and includes:

— *Guidelines on how to draft an SP.* The main purpose of Section 2 is to put the formulation of an SP into perspective, to provide a rationale for the development of an SP and to give an overview of the process.
— *Preparation of an SP.* Section 3 provides detailed, step by step procedures for preparing an SP. It gives a suggested format for the plan and describes the considerations and content of each of its sections. Selected question sets are used which aim at assisting the facility management in tailoring the plan to meet its needs. A number of examples are given for both existing and new RR facilities to illustrate these functions.

In addition, several annexes are contained within this publication, including examples as clarification to the main text and as assistance to the team drafting an SP:

— Annex I: Some strategic considerations that could be taken into account for SP preparation;
— Annex II: Clarification of the application of strengths, weaknesses, opportunities and threats (SWOT) analysis and the relevant probabilistic risk assessment (PRA);
— Annex III: Examples of surveys to determine the capabilities and competencies required for a new RR centre, to quantify stakeholder/user needs and their expectations from the future/existing RR facility;
— Annex IV: Examples of key performance indicators (KPIs) required for assessment and monitoring of RR utilization;
— Annex V: Clarification of the concept of eliminate, reduce, create and raise (ERCR) analysis for achievement of an objective, with a typical example;
— Annex VI: A template as an example of a proposed SP layout (on the attached CD-ROM);
— Annex VII: An example of a completed (but filtered) SP from an existing operational RR (on the attached CD-ROM).

2. GUIDELINES ON HOW TO DRAFT A STRATEGIC PLAN

2.1. MODEL APPROACH FOR DEVELOPMENT OF A STRATEGIC PLAN

The schematic structure outlined in Fig. 1 is illustrative of the approach that should be considered when regarding the development of an SP and its intended outcome.

The outcome (the 'roof' in Fig. 1) of a successfully implemented SP must result in optimized utilization and sustainability of the RR during its lifetime. This can only be achieved if the support system (the 'pillars' in Fig. 1) consisting of the applicable stakeholders is sufficiently well developed to ensure implementation, for example, by utilization of irradiation services, R&D applications, and education and training. A sound basis (the 'foundation' in Fig. 1) for the structure is built according to the stakeholder engagement (through their needs and interests), which ensures that the resources are made available. The resources are normally the facility itself, the funds required and the staff operating and supporting the ongoing activities. These will be discussed in greater detail in the following.

2.2. DEVELOPING THE UTILIZATION OF RESEARCH REACTORS

The SP must address how to develop and increase utilization of the RR by asking two simple questions, which this publication will expand upon:

— What can I do now?
— What should I do now?

An existing RR facility would begin with an evaluation of the facility status and then the stakeholder requirements, whereas a new or proposed facility would begin with stakeholder requirements.

The impact of the answers to the questions 'What can I do now?' and 'What should I do now?' may be best explained in Fig. 2, which shows that there is a certain degree of synergy between current capabilities, future capabilities and stakeholder requirements.

As mentioned above, an existing RR facility will initially examine its capabilities, i.e. 'What can I do now?', and match these with the needs of its stakeholders, i.e. 'What should I do now?', as indicated by the direction of the thick arrow pointing to the right in Fig. 2.

In the case of a newcomer RR, the emphasis in the preliminary SP is to first determine 'What should I do now?', based on stakeholder needs, after which 'What can I do now?' will be progressively developed in assessment exercises, as indicated by the direction of the thick arrow pointing to the left in Fig. 2.

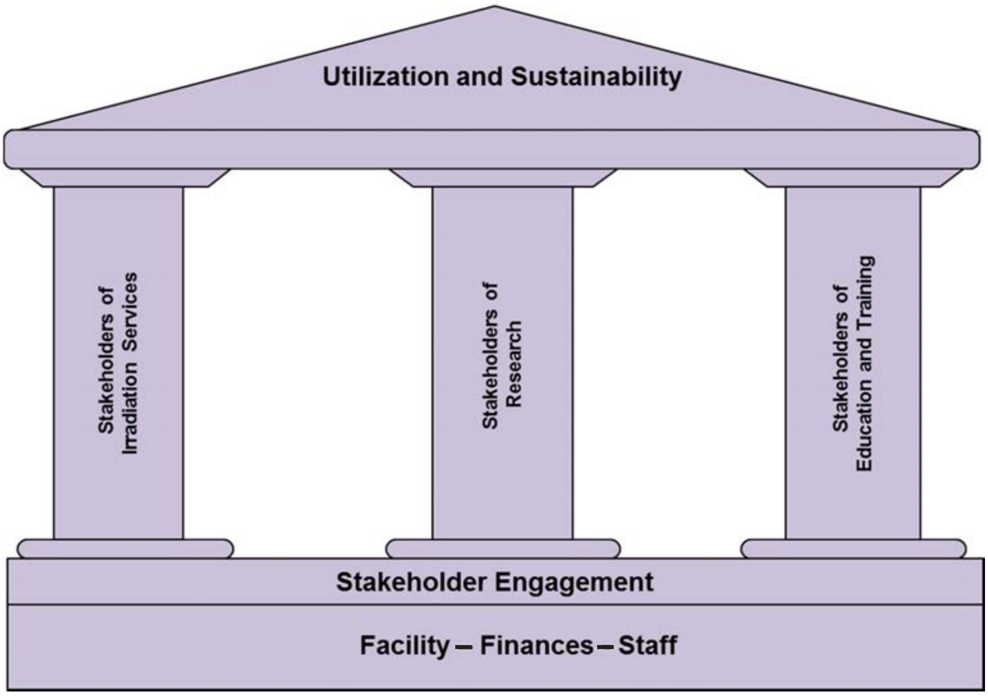

FIG. 1. Model approach for the strategic plan of a research reactor.

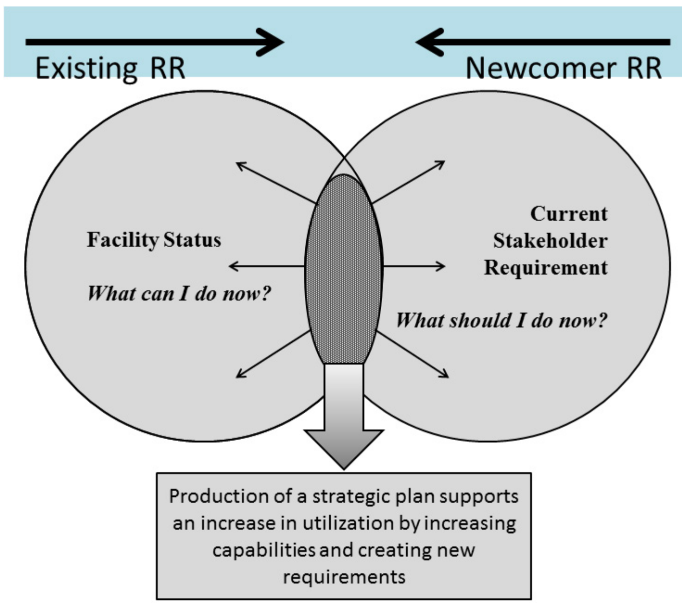

FIG. 2. Strategy for increasing the utilization of a research reactor (RR).

In Fig. 2, the expansion of the facility status circle to the right reflects expanding reactor capabilities, i.e. ‘can do’, to meet more user needs, while the expansion of the current stakeholder requirement circle to the left indicates the increasing needs of stakeholders, i.e. ‘should do’, for current applications.

It is the responsibility of the RR facility management to identify the intersection (shaded area) and to expand on this by matching and improving the abilities of the facility with increasing stakeholder requirements. This publication describes ways of expanding the intersection such that the future utilization factor is greater.

2.3. METHODOLOGY FOR DEVELOPING A STRATEGIC PLAN

2.3.1. Overview

The process of creating an SP mainly involves applying common sense, and for some sections of the SP, just requires documenting what is already being done by existing facilities. These experiences can then also possibly provide examples to new facilities. A brief overview of the process will show that the steps are simple and logically linked together.

An additional advantage of developing the SP is to document the logic and analysis behind the facility's eventual utilization. In the case of an existing facility, as an example, this could avoid the loss of corporate knowledge as an ageing staff retires. In the case of a new facility, it may contribute to the justification and eventual design and specifications of the future RR. During the planning process, while the emphasis might be on utilization and efficient operation, the need for safety and plant improvements as well as lifetime extension, by equipment refurbishment, should not be overlooked.

The strategic planning methodology for an *existing facility* could involve the following steps:

(a) Examine the present and potential capabilities of the facility;
(b) Determine the existing and potential stakeholders and their needs in the utilization of the facility;
(c) Perform an iterative analysis that examines (a) and (b) in the context of the environment and constraints within which the facility operates, in order to:
  (i) Generate a vision of future goals and major objectives (MOs);
  (ii) Decide on a few specific objectives (SOs) and the detailed actions required to achieve them;
  (iii) Implement, review progress and revise the plan.

The process for a *newcomer facility* is very similar:

(a) Determine the potential stakeholders and their needs in the utilization of the facility;
(b) Determine the required capabilities of the new facility based on these needs;
(c) Perform an iterative analysis that examines (a) and (b) in the context of the environment and constraints under which the facility will operate, in order to:
  (i) Generate a vision of future goals and MOs;
  (ii) Decide on a few SOs and the detailed actions required to achieve them;
  (iii) Implement, review progress and revise the plan.

2.3.2. Stakeholders and their needs

A first question to be answered, in particular for a new facility, is 'What should I do now?'

This cannot be answered in isolation. The operating organization must involve stakeholders of all levels who have both existing and potential interests in the facility and its capabilities.

To do this, the facility must first identify 'Who are the stakeholders?' or 'Who might be stakeholders?'

These must include stakeholders from all potential interested parties, including internal, academic, industrial, governmental and regulatory groups.

A typical set of stakeholders, supporters and users for an RR is provided in Fig. 3.

Once the existing and potential stakeholders have been identified, then the needs of these stakeholders should be determined. These needs could contribute to the justification of continued operation or modification of an existing reactor or towards the realization of a new reactor.

Identification of stakeholder needs may be an iterative process between stakeholder problems and needs and a facility's capabilities. Stakeholder concepts, together with approaches for finding stakeholders, are given in more detail in Section 3.5.

The logic behind the identification of stakeholders and their needs and the ability of the facility to meet such needs, either now or in the future, is depicted in the flow chart in Fig. 4.

FIG. 3. Possible stakeholders, supporters and users of a research reactor. Adapted from Ref. [1]. R&D — research and development; TSO — technical support organization.

2.3.3. Capabilities

The next general step in the planning process could be to assess the RR facility capabilities; for example, for an *existing* RR facility, 'What can I do now?', or for a *newcomer* facility, 'What capabilities do I need to meet the expectations of my stakeholders?'

In both cases (existing or newcomer facilities), this assessment might involve a review of previous operating experiences by either the RR facility or other internationally known RR facilities, capturing not only what is being done now and has been successful in the past, but also what experiments or irradiations have *not* been successful (lessons learned). A useful source of reference here is Applications of Research Reactors [3].

The next stage might then be to brainstorm possible new tasks, assess what the competition is doing and refer to guidance material regarding potential capabilities. This stage might reveal new applications or opportunities, for example, as reflected in Ref. [3].

In addition, it should be noted that there are often non-technical drivers for accepting or rejecting new directions, such as the desire to develop an independent national capability in a particular field, such as operator training in a new nuclear power programme.

In the case of newcomer RR facilities, the identification of potential stakeholders and their expectations and needs should essentially form the basis of defining the specifications of the RR facility. These include the ultimate reactor design, applicable power level, irradiation and neutron beam facilities, radioisotope production facilities, analytical laboratories, etc.

2.3.4. Analysis

An essential part of the preparation of an SP is to start with an examination of the current status of the facility, or, in the case of a new facility, its proposed and potential resources. Such an analysis will assist management in deciding on whether expansion of services to increase the facility's potential utilization is justified. On the other hand, the evaluation may indicate if there are any significant risks that could result in the temporary or permanent shutdown of the facility.

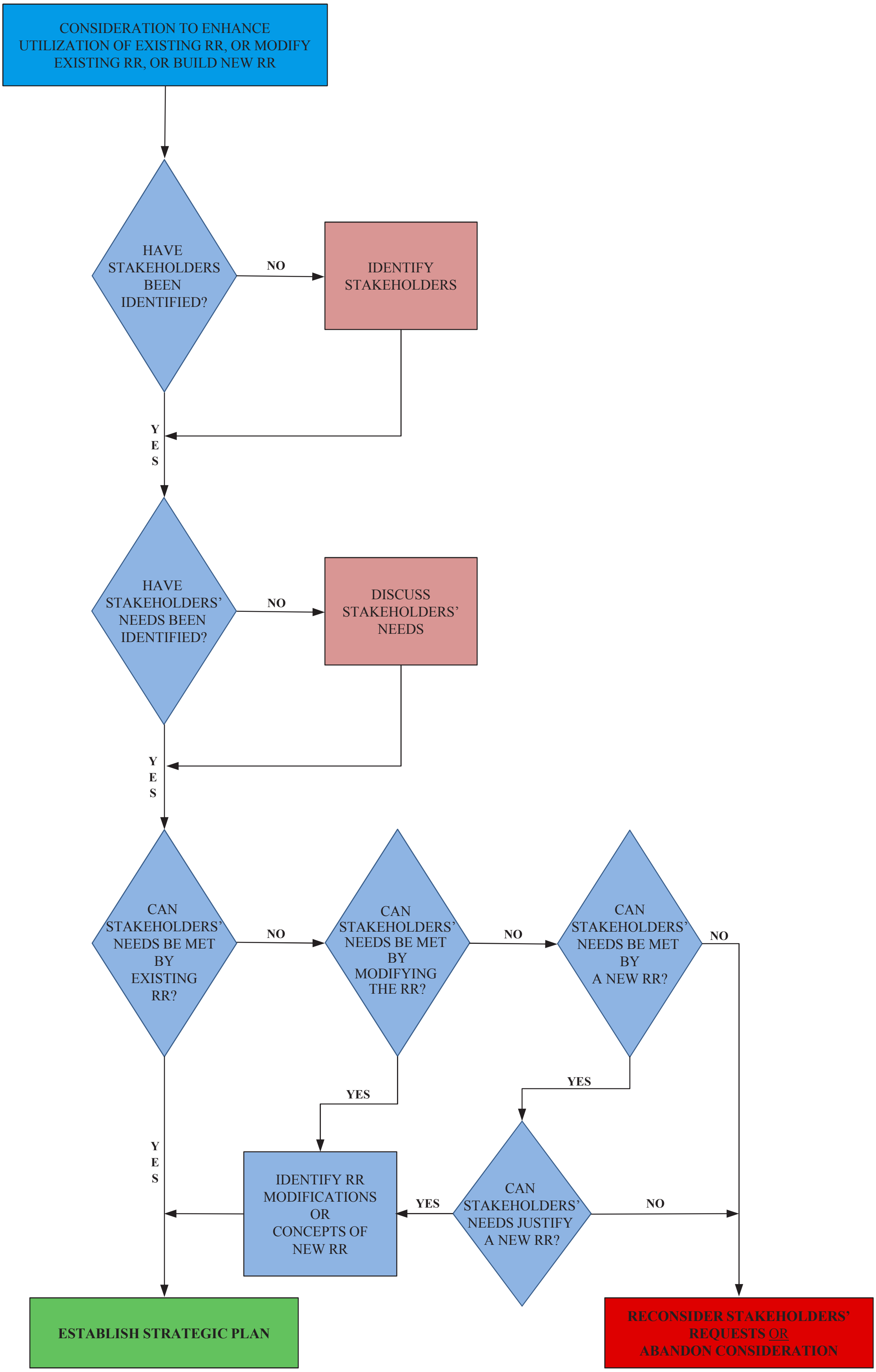

FIG. 4. Example of a simplified stakeholder and needs identification decision tree. RR — research reactor.

2.3.4.1. Strengths, weaknesses, opportunities and threats analysis and probabilistic risk assessment

A SWOT evaluation is an analysis methodology that can be used to aid decision making in the case of both existing and newcomer RR facilities. Clearly, this is not an isolated process, as one must assess what resources are available or could be available and what realistic risks might prevent any proposed implementations. This information is then put into context and analysed within the framework of the environment and constraints applicable to the facility as a PRA[6], which will be explained in more detail in Section 3.8 and Annex II.

As an example, the outcome from a SWOT analysis regarding stakeholder requirements and the facility's capabilities might be a table divided up into four opportunity categories: 'can do', 'could do', 'can't do' and 'don't want to do' (see Table 2).

TABLE 2. EXAMPLE OF SORTING OPPORTUNITIES FOR UTILIZATION OF A 100 kW POOL TYPE REACTOR

'Can do'	'Could do'	'Can't do'	'Don't want to do'
Production of tracer radioisotopes	Ar-41 production	Mo-99 production	Dissolve bromine
Training of undergraduates	Training of regulatory authority staff	Training of nuclear power programme operators (e.g. no nuclear power programme in the country)	
Silicon doping research	Demonstration experiments for educational purposes	Industrial scale silicon doping	
'Standard' neutron activation analysis	Large sample neutron activation analysis		Large scale commercial neutron activation analysis

Although the examples in Table 2 refer to utilization opportunities, it must be emphasized that the SWOT and PRA analyses can also be readily applied to various managerial categories, for example:

- Finances;
- Human resources;
- Science and R&D applications;
- Irradiation and/or beam facilities;
- Reactor operation schedules;
- Regulatory issues;
- Fuel supply;
- Utilities (e.g. steam, water and electricity supply, and waste disposal).

Irrespective of whether the analysis is performed for an existing or new RR facility, the outcome of the SWOT analysis should then lead to specific conclusions and the ultimate definition of proposed strategies. These, in turn, should lead to some MOs for the future of the RR facility, as depicted in Fig. 5, becoming the central focus of future efforts of the facility's SP. Each MO should then cascade into one or more SOs with detailed action plans (APs) for achieving those objectives. The SWOT analysis methodology can then be readily applied to each individual level of the cascade, as depicted in the same figure. This approach is discussed in greater detail in Section 3.8 and Annex II.

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[6] Note that the term 'risk assessment' is of very general nature and should not be confused with the term 'risk assessment' defined in the IAEA Safety Glossary [4], where it is limited to the "Assessment of the **radiological** risks associated with normal operation and possible accidents involving a source or practice".

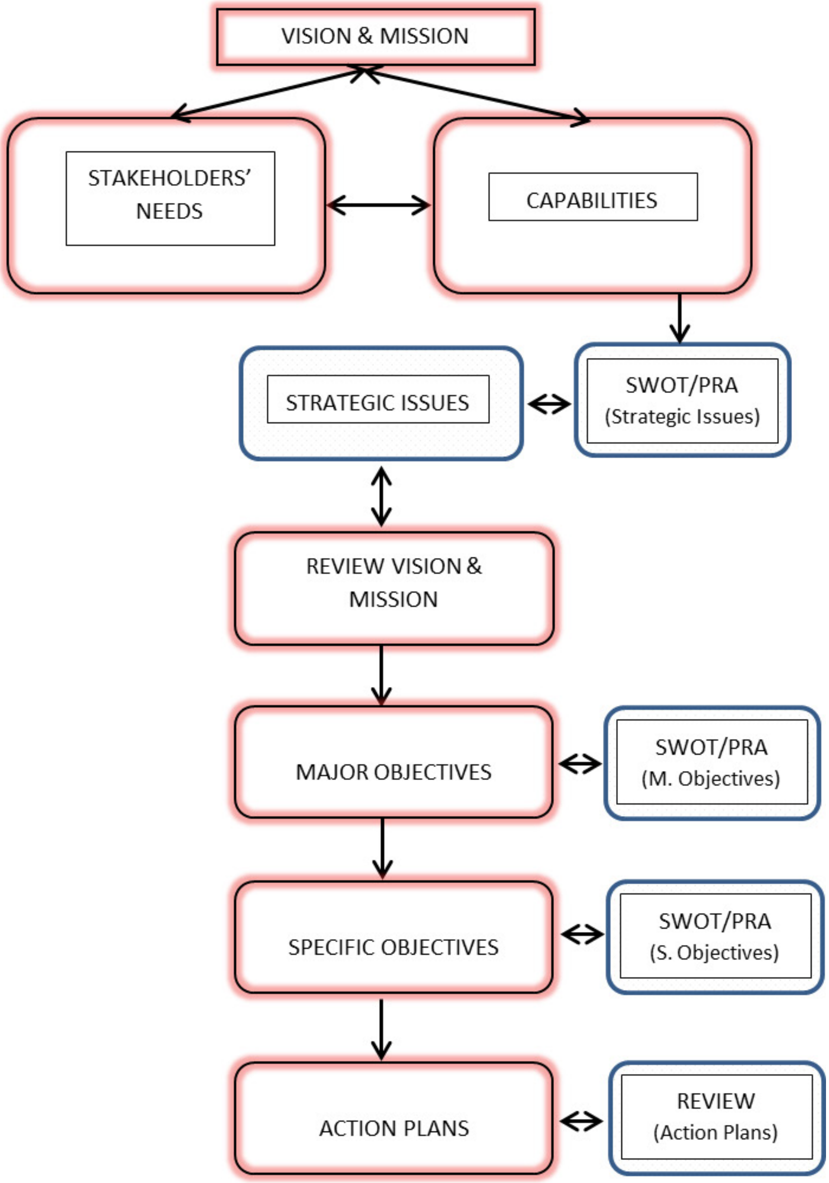

FIG. 5. Outline of the strategic planning methodology. M. Objectives — major objectives; PRA — probabilistic risk assessment; S. Objectives — specific objectives; SWOT — strengths, weaknesses, opportunities and threats.

The SWOT analysis for a newcomer RR facility, in particular one becoming the first of its kind in a country, should end up with a 'should do' list, relating to stakeholder interests. The drafted preliminary SP then forms the basis for defining the specifications for the new reactor.

The SWOT analysis outcome for either a newcomer or an existing facility will be tables of capabilities similar to the four opportunity categories as described in Table 2. In most cases, the outcome of a SWOT analysis and the decisions for a new strategy will also call for an assessment of operating costs and potential income, as well as a change in mindset or culture in the management and personnel of an organization. Guidance for management of such changes is addressed in Section 3.17.

2.3.4.2. Life limiting factors

It is quite possible that the evaluation of a facility's status can produce a negative result. As an example, a potential shutdown of a reactor is often referred to as a 'life limiting factor'.

It would not be sensible, for example, to plan for new stakeholder utilization if the reactor licence is due to expire soon and is unlikely to be renewed due to serious vessel or fuel corrosion problems. Life limiting factors will tend to be assessed when the licence renewal process is initiated or the safety analysis report is updated. In fact, it might be wise to reassess these matters before undertaking any strategic planning.

It is also possible that the above evaluations could result in a conclusion, for example based on the financial or other resource limitations, that further operation of the facility is no longer justified. In such a case, consideration should be given to preparing an SP to shut down the facility and prepare for its decommissioning.

2.4. CONTENTS OF A STRATEGIC PLAN

Using the methodology discussed above, the model structure for an SP, as proposed in Fig. 5, and outline of the contents of a typical SP document is:

(a) Executive statement: a statement of the management commitment;
(b) Executive summary: a summary of the plan;
(c) Vision and mission: a concise statement of direction;
(d) Introduction: the driving forces for the plan;
(e) Stakeholders: who are they and what are their needs?
(f) Facility description: a brief review of the facility;
(g) Capabilities: existing and potential capabilities/applications;
(h) SWOT and PRA: analysis and conclusions;
(i) Decisions and strategy: a basis for the new strategy;
(j) Strategic considerations: factors that impact the chosen strategy;
(k) Objectives:
  (i) Major: a few selected priority goals;
  (ii) Specific: achievements that result in reaching an MO;
(l) Specific APs[7]: the detailed steps for fulfilling each SO;
(m) Review and status reporting: checking the implementation of the plan and updating it.

In addition to the contents of a typical SP as listed above, the following sections should also form part of the SP:

(n) Organization and personnel: organizational structure and responsibilities;
(o) Financing: balancing the budget of income and expenditure;
(p) Outreach and marketing: promoting the facility's benefits to stakeholders and improving user awareness of utilization abilities as well as looking for market opportunities;
(q) Change management: adaptation of management and personnel to possible new changes in culture.

The model SP structure suggested above is expanded in Section 3.

3. PREPARATION OF A STRATEGIC PLAN

This section highlights a step by step method for preparing an SP for an RR. A model SP will have steps addressing the key items listed in Section 2.4. Each of these steps is explained below in greater detail, to enable the responsible management to prepare a complete and useful SP.

[7] Specific APs, often described as management plans, could be separate documents from the SPs and would describe plan details including timelines and metrics of success leading to completion of MOs. In such cases, the SP documents will normally summarize and reference such APs.

In general, the strategic objectives addressed in the SP of an RR facility will have been derived from a higher level strategy document (e.g. from the stakeholder government department or the SP of the organization operating the RR). The responsibilities for the SP preparation and coordination of strategic considerations are allocated by the applicable senior management of the RR facility. It is again emphasized that participation in the preparation of the SP by all relevant stakeholders should be encouraged and that the process of preparing an SP should be a team effort, as this ensures a form of 'ownership' and resulting commitment of all involved.

It must be clearly stated that an SP is prepared according to the interests of the stakeholders. However, it always remains the prerogative of the responsible management to decide on the levels of sensitivity and to accordingly edit information, such as business processes or detailed financial and personnel related information, prior to distribution to the various stakeholders.

3.1. EXECUTIVE STATEMENT

In this first section of the SP, the executive support of the company or potential owner of the RR should be described. A way of doing this is to have a signed statement by a high level stakeholder (e.g. a director or general manager) that outlines the importance of running the existing or planned RR and confirms that the upper management is committed to developing and implementing the SP.

3.2. EXECUTIVE SUMMARY

The executive summary typically presents the key elements, MOs and conclusions of the SP. It should include, if necessary, changes in philosophy, financial considerations, installation of new equipment and establishment of planned alliances. Furthermore, there should be some short statements regarding the preparation (e.g. methodology, time, resources allocated, capabilities and responsible persons) and confidentiality of the SP itself. The executive summary can also outline the company or owner values and the link between these and the RR.

3.3. VISION AND MISSION

Visioning could take place at several points in the strategic planning process, although there can be some benefit to establishing it before the realities of the strategic items are considered.

The vision of the facility should be the desired state of achievement to be reached in the future. As an example, the vision of an RR facility could be:

'To be the regional neutron source for academia and industry'.

Generally, the vision of a facility should be formulated jointly by those directly involved in achieving this vision, taking the considerations of the various stakeholders into account.

A mission statement, on the other hand, is the method or way that the facility will go about achieving its vision. The mission statement should clarify briefly *how* the futuristic but still realistic goal will be reached. An example clause in the mission statement of the facility could be:

'To meet all the radioisotope production needs of the State'.

3.4. INTRODUCTION

The introduction should provide the context for all stakeholders and the staff about why an SP is needed for the existing or planned RR (e.g. to realize national capacity in nuclear science or production of radioisotopes, to increase the utilization of services or products or to improve their efficiency). This section should briefly state the MOs of the SP and how and when it should be used, and should outline its structure. Finally, there should be a statement about the frequency with which the SP should be reviewed to ensure that it stays current. A review frequency of at least once per year is advisable.

3.5. STAKEHOLDERS AND THEIR NEEDS

Stakeholders can be defined, in this section of the SP, as the person(s) and/or institution(s) that have a direct or indirect interest, or involvement, in the operation of the facility. Stakeholders can be either internal or external, and may have an authoritative (managerial), utilization, financing or advisory role. They should not be confused with ‘shareholders’, who have an investment interest in the facility.

The contribution of the various stakeholders to the planned activities of the facility can be significant, and should thus be determined before the objectives of the SP are identified. It is essential that relevant stakeholders, as well as their requirements (needs), are clearly identified. It is possible that the needs and missions of stakeholders will conflict, such that the RR facility will need to consider which stakeholder needs will be met and which will not, or how to otherwise resolve the conflicts.

3.5.1. Identification of existing stakeholders

The following examples could be of assistance in determining the facility’s stakeholders. In the evaluation, a positive answer to a question implies that the particular stakeholder is probably relevant to a facility’s strategic planning.

In the case of an intended newcomer facility, the questions asked could be more futuristic: ‘will you?’, rather than ‘are you?’ or ‘do you?’

3.5.1.1. Government

Normally, this body (typically a governmental department) handles the political and financial policies that will be applicable to the facility; as such, it could play a major role in the decision or strategy making process.

The following questions are just to illustrate the possible types of involvement of a government as a stakeholder of an RR facility:

— Are you currently, or could you in the future, be under the control of a governmental department?
— Do you receive direct or indirect government funding (e.g. as part of a (State) university or national research centre)?
— Does the governing body stipulate your basic purpose for operating (e.g. are you primarily a facility focused on research and testing or mainly on commercial activities, or both)?
— Are there political aspects that you have to take into account (e.g. participation in a programme to convert from high enriched to low enriched fuel)?
— Do you have interactions with government organizations (e.g. forensic institutions, customs offices and health organizations)?

3.5.1.2. Upper management

Generally, the decisions of the immediate (next level of) management have the most direct impact on a facility’s future. Ideally, these should already be defined in an existing SP for that managerial level. They could relate to the following considerations:

— Are the resources available to your facility directly controlled by a higher managerial level?
— Are there specific requirements set by your management regarding operational requirements (e.g. fund availability)?
— Is decision making regarding operation of your facility based on the input of more senior management?

— Have certain MOs and SOs pertaining to the performance of your facility been predefined elsewhere (e.g. pre-identification of institutional responsibilities as an essential part of operation)?
— Is your facility included in a higher level SP?

3.5.1.3. Academic institutions

Universities, technical education centres or national research centres are often owners and internal users of RR facilities for R&D, as well as for education and training. The impact of such stakeholders is illustrated by positive responses to questions such as:

— Is the facility owned by a university or located on a university campus?
— Do you have established or potential agreements with particular universities or technical education centres regarding utilization of your facilities?
— Are you involved in a nuclear education programme at any academic institution or at a national/regional level?
— Do faculty researchers have significant equipment or laboratories set up around the RR facility?
— Do you provide a service (either free or for remuneration) to academic institutions?

3.5.1.4. Industrial and private sectors

Industrial and private sector stakeholders are those that have products and/or services (including R&D) provided to them by the facility, generally on the basis of a financial agreement. These stakeholders can be classified as internal or external to the institution.

Some examples of clients (end-users) are:

— Nuclear power plant or nuclear utility owners or service contractors;
— Radioisotope producers, users and exporters;
— Manufacturers and industrial companies.

These stakeholders have their own interaction with the facility, and, as an example, the following aspects may have to be considered:

— Do you provide services to paying clients?
— Is there a significant financial income to the RR facility associated with these clients?
— Does supplying products or services to paying clients significantly affect the reactor's operating or maintenance schedule?
— Is there a return of revenues to the RR facility or the applicable institution?
— Are there clients with their own instrumentation and staff at the reactor or its institution?
— Are the clients dependent on the continued operation of the RR facility for their business needs?

3.5.1.5. Regulatory body

The authoritative licensing body or its technical support organization (TSO), if it exists, will provide direct requirements for the safe operation of the facility and will thus be involved in overseeing the activities of the facility.

This stakeholder involvement leads to other questions that need to be taken into account, for example:

— Is the safety and security infrastructure adequate to comply with legal and regulatory requirements?
— Do you have to satisfy requirements such as periodic safety reviews and security assessments?
— Have all the requirements from your regulators been considered (e.g. the establishment of a decommissioning and dismantling plan)?

— Are you involved in the training or development of the regulatory body’s personnel?
— Will you be able to muster support from other involved organizations to meet regulations such as those for emergency planning and response?

3.5.1.6. Personnel

The staff involved in the operation and direct support activities of the facility are key contributors to the success and safe and secure operation of the facility. It is important to recognize that they too are stakeholders with their own needs (e.g. career development, job security, motivation, job satisfaction and income) to be met.

A facility takes account of the involvement of these stakeholders when questions such as the following are successfully raised:

— Do you have the means necessary to develop and support the personnel needed for the facility?
— Are your personnel fully utilized and well trained?
— Are other personnel at your institution (excluding facility staff) directly involved in the utilization of your facility?
— Do you have a knowledge management or skill development and transfer programme, in particular for staff attrition due to retirement?
— Do you have a succession plan for replacing essential personnel?

3.5.1.7. General public

The public perception of the facility and its uses can be a major concern. This will often depend upon the type of relationship that has been developed with the local population and the media over a period of time.

The facility should not underestimate the importance of the general public (e.g. the local municipality and its response forces) as a stakeholder and may pose the following questions:

— Is the local public aware of the facility’s existence?
— Is there opposition to the facility?
— Do you have a public relations or public outreach programme?
— Are you involved with the local community?

Some suggestions regarding outreach activities are given in Section 3.16.

3.5.1.8. International Atomic Energy Agency

The IAEA is a possible stakeholder of the reactor because it contributes to a Member State mandate, i.e. the demonstration of the peaceful use of facilities for nuclear applications. Some facilities have legal research contracts or research agreements with the IAEA, and many others request assistance via the technical cooperation department or other regular budgetary activities. In addition, most facilities are under IAEA safeguards agreements and routinely undergo inspections.

The stakeholder involvement of the IAEA is illustrated by questions such as:

— Have you submitted an SP for review to the IAEA?
— Do you have regular contact regarding the acquisition of technical information from, or its provision to, the IAEA?
— Do you receive assistance from, or provide it to, the IAEA (i.e. for specialized or technical matters)?
— Do you have an IAEA research contract or research agreement?
— Do you provide services to the IAEA such as fellowship training, scientific visitors, provision of experts, hosting of IAEA meetings, etc.?
— Do you have, or want to have, an IAEA technical cooperation project for your facility?

— Have you taken into account the Code of Conduct on the Safety of Research Reactors [5] and the IAEA safety standards?
— Do you operate under an IAEA safeguards agreement?

3.5.1.9. Others

A variety of other stakeholders — local, national or international — could be of significance to the facility's strategic planning.

The facility may identify these stakeholders by the following assessments:

— Are there any other technical assistance bodies or institutions that make a contribution to your facility's operation, such as TSOs?
— Are you a TSO for your national regulatory authority or nuclear utility company?
— Are you a member of a regional network or coalition?
— Do you have a specific RR user group/organization?
— Are any of your personnel involved with external organizations (e.g. for metrology)?

3.5.2. Identification of new stakeholders

The RR facility should be able to demonstrate to all potential stakeholders that it may have capabilities that could contribute to solutions for local, national or regional/international needs. The main local, national and regional industries, including agriculture, health and academic institutions, should then be identified. Their needs should be specifically addressed to determine if there are possible RR nuclear techniques applicable to meet such needs. Reviewing earlier requests from stakeholders and also focusing on the reasoning behind possible negative responses at that stage may be of some assistance.

A subsequent step would be to evaluate the existing users and to determine if there are other similar users. Current clients may often be able to indicate who else is doing similar work.

Outreach and marketing are essential activities to assist in the identification of new stakeholders. These are addressed in more detail in Section 3.16.

The identification of new stakeholders and, in particular, new users often requires more creative thinking and effort than simply communicating with existing users. The IAEA assists in this process by providing guidance material on the methodology for the stakeholder survey (see Annex III). The IAEA also provides published reports on potential applications of RRs, including commercial products and services [3, 6, 7], and supports the organization of national stakeholder and user workshops.

A source of potential new users can possibly also be those local, regional or international clients that are using RRs similar to your facility around the world. There might be an opportunity to increase the RR facility user base by considering the replacement of services or products of the clients or communities of ageing RR facilities or RR facilities no longer in use. Management or scientific staff could orientate themselves by, for example, scientific visits to similar facilities and by studying literature on applications of other RRs.

The importance of involvement in RR networks and coalitions and regular orientation at international conferences/workshops must be emphasized. Cooperation with other regional RRs may be of interest — for example, participating in related R&D projects or providing irradiation or training backup services while neighbouring RRs are temporarily shut down for maintenance. As an example, an international RR network agreement could be considered to ensure continuous supply of ^{99}Mo to health institutions.

3.5.3. Needs of stakeholders

It follows that once specific stakeholders have been identified, the next step is to determine each of their requirements or needs. There are various ways that stakeholder requirements could be determined, but basically they all involve proactive interaction. A few examples are:

— Personal visits with existing clients;
— Distribution of promotional pamphlets with easy response questionnaires;

— Establishment of web sites that are responsive to user queries;
— Visits to academic institutions with presentations by and discussions with the faculty and students;
— Attendance at technical conferences in the applicable fields, presenting options and listening to potential applications;
— Open house opportunities at the facility (e.g. technical information tours);
— User forums, workshops or discussions in brain storming sessions;
— Literature studies and subsequent proposals for projects;
— Cooperative projects with several stakeholders (e.g. IAEA for national or government related projects);
— Annual user and staff satisfaction surveys.

The needs of stakeholders can generally be categorized into three areas:

— Needs that are known, can be specified and can be acted on immediately;
— Needs that are known and can be specified, but should only be considered for future action;
— Needs that are unknown and require more information and promotion by the facility as feasible or worthwhile to the stakeholder.

Some examples of needs for each category of stakeholder are:

(a) Government: increase the ratio of budget from earned income/government funding[8];
(b) Upper management: improve the operational efficiency;
(c) Academic: develop new experimental facilities, education and training;
(d) Industrial and private sectors:
    (i) Deliver new isotopes at a different time or place;
    (ii) Expand production capacity (e.g. doped silicon);
    (iii) Develop new products or build new test facilities;
(e) Regulatory body:
    (i) Define the lifetime of the reactor;
    (ii) Develop new requirements for the enhanced safety and security or lifetime extension of an RR;
(f) Personnel: enhance working conditions (e.g. career paths);
(g) Public: provide information on what the reactor is being used for and how it might be beneficial; ensure that there are no off-site airborne releases;
(h) IAEA: provide effective local knowledge management and increase self-sustainability; provide fellowship or safeguards training for IAEA trainees;
(i) Others:
    (i) Participate as an Internet reactor[9] in regional training;
    (ii) Provide transboundary access for researchers from other countries.

During the evaluation of stakeholder needs, it should be ensured that stakeholder needs are quantified as completely as possible, for example, number of becquerels per week of radioisotopes, number of analysed samples per month, number of people trained per year, total mass of doped silicon in tonnes per year, etc.

3.6. FACILITY DESCRIPTION

This section of the SP should be a short description of the reactor itself, for either an existing or a proposed RR facility. The reactor's ancillary equipment and structures should also be clearly explained in order to assist the reader (in particular, the non-technical managers and executives) to understand the specific items and objectives outlined in the SP.

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[8] Bans and restrictions on commercial revenue generation by an RR facility can possibly be overcome using exchange or countertrade mechanisms (i.e. goods for services).

[9] Internet reactor capability allows remote transmission of courses and experiments through Internet and video conference from an operating research reactor (host facility) to an institution without such a facility (guest facility).

As an example, information such as the layout and dimensions of the reactor vessel or pool, the reactor power and the number of irradiation facilities and beam tubes might be given. A typical operation schedule such as operating hours per day, days per week, weeks per month, etc., should be provided.

The description should not be too technical but should rather include references to relevant technical or operational documentation. The IAEA Research Reactor Database [7] is readily available as an external source of relevant data. It is the responsibility of the RR facility manager to make sure that these on-line data sources contain current information.

3.7. CAPABILITIES

This section of the SP is relevant for all RRs because it allows the responsible person(s) (e.g. facility management) to precisely identify the key capabilities of the organization and the extent to which such resources are available. While the emphasis is on the reactor, the competencies of the ancillary facilities, staff and support units should not be overlooked. This can also include all service or utility provisions (e.g. water, electricity, steam and waste management). As an example, there might be a significant reactor physics computational capability present at the site.

3.7.1. Existing capabilities

The types of projects and services that are currently available, or have been provided in the recent past and are still viable, should be clearly listed in the SP. Depending on the organizational structure, the capabilities of affiliated support units should also be identified. Alliances with these groups can strengthen the overall usefulness of the facility. For example, one might be able to offer a materials elemental analysis service using specialized applications[10].

Examples of some capabilities could include:

- Production of certain isotopes at specific activities either periodically or on request;
- Neutron activation analysis at a specified precision for a given sample throughput;
- Access to neutron beams and associated instrumentation;
- Physics measurements for validation of certain computer codes and detector testing;
- Materials testing by in-core irradiations at specified flux rates and neutron spectra;
- Remote inspection tooling development;
- Operational R&D programmes;
- Scientific and technical competence;
- RR user group;
- Training and educational programmes;
- Radiological emergency response team capability.

The above capabilities should preferably be quantified as much as possible (e.g. not only which radionuclides or experimental facilities are available but also neutron fluxes, maximum irradiation time, operational schedule, number of experiments per year, either at no cost or as a paid service). These would be typical responses to the questions: ‘how much?’, ‘how many?’, ‘how often?’, etc.

The quantification of facility limitations is important advance information for potential users, for example:

- The batch quantities possible for irradiations;
- The number of samples that can be analysed (e.g. by neutron activation analysis or neutron diffraction);
- How many persons can be trained and at which level (e.g. BSc, MSc, PhD);

[10] Neutron activation analysis, prompt gamma neutron activation analysis, instrumental neutron activation analysis, delayed neutron counting and neutron depth profiling.

— How many students can take part in research and from which affiliations;
— What type and how many other experiments can be performed.

3.7.2. Potential capabilities

Once current capabilities have been identified, it becomes necessary to see what else the reactor could do in view of existing and future stakeholder needs. This will, in particular, apply to situations where a new or significantly modified facility is being considered.

A suggested approach is to refer to the applications presented in Ref. [3], which reports current uses of RRs and the necessary criteria to enable an application to be implemented. In addition to being a source of information for newcomer RR management to match a future RR with stakeholder requirements, it would also be of particular benefit to those seeking to increase the utilization of an RR or to modify the RR for a certain application.

The applications are presented progressively from those that are possible at any reactor, such as education and training, to those that require a higher power and more specialized experimental facilities. Information about the required capital investments and human resources is also provided. The report gives a simplified RR capability matrix, which, at a glance, enables determination of the applications that may be appropriate for a reactor of a particular power level. For example, it may be seen that a 100 kW reactor is quite capable of performing good neutron radiography, but would not be suitable for silicon doping.

If applicable, facilities may then also consider extension of their capabilities by an increase of reactor power within the technical and licence limitations.

Additional quantification of potential capabilities is also to be applied in this section. The facility management should be able to provide responses to, for example, ‘how much?’ or ‘how many more?’ can be accomplished, if stakeholders request this. The possibility of reactor schedule extensions beyond a few hours per day or a few days per week, or by automation of facilities, should be provided.

Once the above exercise has been completed, additional potential capabilities should be put on a separate list that will be used when assessing opportunities to increase reactor utilization.

3.8. STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS ANALYSIS AND RISK EVALUATION

3.8.1. Strengths, weaknesses, opportunities and threats

SWOT is a management tool for structured assessment of the ability or need for an organization to change. It is based upon categorizing functions or tasks as a result of information gathering, for example, at a user meeting, as part of a presentation or in a brain storming session. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favourable and unfavourable to achieving that objective. The details could then be finalized in follow-up discussions with the major stakeholders.

Once the data gathering phase has been completed, the analysis phase should begin. This could start with the identification and quantification of each of the stakeholder potential needs. The process may involve iterative communication with the stakeholders, to be followed by an evaluation of the constraints or strategic items that must be considered before conclusions regarding the MOs and SOs are established according to a priority ranking. After establishing these objectives, the work plans or APs must be developed.

It must be emphasized that the SWOT analyses can also be readily applied to various managerial categories, irrespective of the level of complexity, as shown in Fig. 5.

An example of a SWOT analysis for an existing capability of a reactor (production of radioisotopes) is illustrated in Table 3, with a series of questions as well as some examples.

TABLE 3. EXAMPLE OF STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS ANALYSIS FOR ISOTOPE PRODUCTION

Strengths	Weaknesses
What do you do particularly well? Are you the best in class in any areas? Do you have acceptable waste management in place? Do you have a confirmed fuel supply and take back policy?	Do you have any actions not fully implemented? Are there tasks done less well? Are there operational areas or safety related matters that are poorly understood?
Examples: Supply of 90% of the national requirement for radioisotopes; waste management system is in place; fuel supply is confirmed for next 10 years	**Examples:** Underdeveloped quality assurance system for isotope export; only one operational shift can be ensured by available licensed operators
Opportunities	**Threats**
Have you identified any new markets or areas of utilization? Are there any work areas with room for full implementation? Are there any tasks done less well with room for improvement?	Are there work areas done badly? Are there concerns about safety critical equipment? Are your competitors much better than you? Do you have any life limiting factors? Are there research and development fields from which you could be excluded?
Examples: Export supply of half of the region's Mo-99 needs; client complaints that can be addressed	**Examples:** No target material for radioisotope production available in a few years' time; large number of staff due to retire soon

The examples given in Table 3 indicate how the application of the SWOT methodology can result in various conclusions regarding objectives that need to be considered. In the case of the quality assurance weakness identified, an MO might be: 'Establish a quality assurance system that satisfies the requirements of export clients'. Breakdown into SOs and related APs will then follow.

Although there are similar evaluation methods available internationally, the SWOT approach is adapted here as a logical assessment method that can assist the RR facility management in identifying those priority areas on which to focus their actions. An example is provided in Annex II.

3.8.2. Assessment of risk

Based on the outcome of the SWOT analysis, a priority ranking of the MOs should be established. In particular, the impact of weaknesses and threats could be evaluated. An example is given in Annex II.

During the SWOT process, decision makers should consider whether the objective is attainable. If the objective is not attainable, this must be recognized, and an alternative objective must be selected and the process repeated as needed. In certain cases, this might require evaluation of any life limiting factors.

3.8.3. Life limiting factors

As part of the risk evaluation that might sensibly take place before making decisions on increasing investment of any kind, one might want to address the expected lifetime of a facility by asking the following types of questions:

— Does your government provide any requirement to maintain a strategic facility operational?
— Is your facility under financial pressure to generate revenues and cover part of your operation and maintenance costs?
— Are there any plans to replace your reactor with new reactors?
— Is it likely that the use of your site might be limited (e.g. due to environmental reasons)?

— Have you lost major local users (e.g. is there a loss of interest at universities for (continuing) academic education in nuclear sciences and engineering?)?
— Are you losing international, regional or national clients?
— Have your nuclear power plants moved to simulators for their operator training?
— Do you have problems with the structural, seismic or electrical standards of your equipment?
— Are you pressured by a take back programme for your fuel?
— Do you have a guarantee for middle term and long term fuel supply?
— Do you have problems with the structural integrity of any core internals, including fuel?
— Are there any reasonably foreseen events coming out of a safety reassessment that might threaten the site (e.g. post nuclear incident safety requirements)?
— What might be the impact of a problem with the reactor tank or any underground pipework?
— Do you have capable staff available now and in the foreseeable future?
— Do you have any licensing issues or adverse political or financial aspects to consider?
— Do you have uncontrollable or excessive unexpected costs?
— Does the integrity of your instrumentation and control systems pose a lifetime problem?

Typically, most of these topics, if applicable, will already have been identified as weaknesses and threats in the SWOT analysis. Some of these factors might be turned around with effort and could then help to ensure a healthy future for the reactor.

3.9. DECISIONS AND STRATEGY

The outcome of the assessment of the needs of the stakeholders, together with conclusions from the SWOT and PRA results are then used for decision making and recommendations on the strategies to be followed, where strategy is defined as a high level plan to achieve one or more goals under conditions of uncertainty.

As identified earlier (see the example in Table 2), the process of categorizing stakeholder needs may be initiated with a matrix of capabilities divided into four categories: ‘can do’, ‘could do’, ‘can’t do’ and ‘don’t want to do’. These categories should include objectives leading to actions to overcome related weaknesses and threats by optimizing the facility’s established strengths and recognizing potential opportunities.

3.10. STRATEGIC CONSIDERATIONS

After having evaluated the results of the SWOT or alternative analyses, several considerations that can influence the facility’s strategy may be identified. In order to prioritize and decide which of these strategic considerations should be taken into account in an SP, the facility should preferably have the guidelines or requirements of the next higher level of management available for reference (e.g. in a higher level SP).

As discussed earlier, the evaluation of the facility’s status and capabilities, together with the stakeholder requirements and an appropriate SWOT analysis, should result in the answer to the questions relevant to the development of the strategy: ‘What can I do now?’ and ‘What should I do now?’ In addition, it should also enable the preparation of the objectives discussed below.

The following are examples of typical strategic considerations that could apply to this section of the SP:

(i) Facility operations and management;
(ii) Stakeholder and user relations (*);
(iii) Marketing (*);
(iv) Financial management (*);
(v) Maintenance;
(vi) Licensing and regulation;
(vii) Quality management;
(viii) Health, safety and the environment;
(ix) Technical cooperation and information exchange.

The above categories are described in greater detail in Annex I and selectively (marked with *) in Sections 3.5, 3.15 and 3.16.

3.11. OBJECTIVES

It should be clear that the development of an RR facility's capabilities is directly related to the stakeholder needs and identification of the facility's vision and mission.

In turn, the vision and mission identify the set of MOs to be considered, and each of these MOs will cascade down into a set of SOs. Depending on the complexity of the SOs, the cascades can continue downwards until a level of implementation can be defined. The implementation levels are, in fact, the APs required to ensure that each level under consideration is achieved. The progressive implementation of the applicable APs is then regularly monitored according to a suitable schedule and review mechanism such as KPIs, and the APs are adjusted accordingly.

This methodology is depicted in the schematic diagram in Fig. 6.

3.11.1. Major objectives

The decisions forthcoming from the conclusions of the SWOT analysis on the strategic issues will enable the RR facility to identify a limited number (e.g. from three to five) of the most important MOs that will move the facility in the direction of its vision. Some of these objectives may address activities that are already ongoing and need to be continued (e.g. periodic safety assessment), as well as new objectives designed to resolve matters or develop new areas of expertise or business opportunities for the facility. It should be emphasized that these objectives should not be limited to opportunities only, but could also focus on actions to overcome weaknesses and for anticipating threats.

Some questions that could allow the facility staff to identify the MOs include:

— What level of utilization would be ideal for this facility?
— What are the major technical challenges that are now facing the RR (e.g. ageing vessel or water leakage)?
— Are there any major issues with the regulatory agency (e.g. major upgrades to permit operating the RR beyond a certain date)?
— Are there any important environmental matters (e.g. high ^{41}Ar releases from the RR or radioactive waste management)?
— Is there potential for loss of expertise (e.g. reactor physicists being recruited by outside organizations)?
— Do you have major budget concerns (e.g. stakeholders requiring that the facility finance a significant portion of the operation or construction budgets)?
— Can you afford to expand your operation schedule in view of fuel consumption costs, costs of additional operators, security, etc.?
— Do you have major radioactive waste liabilities?
— Do you have reactor safety matters?
— Do you have fuel supply concerns?
— Are there any new needs/concerns arising from the RR users/stakeholders?

Based on the data gathering and subsequent analysis, an example of an MO that an RR facility might choose is: 'To increase the level of utilization of the RR by the supply of irradiation products and services to stakeholders' (see Annex II).

3.11.2. Specific or lower level objectives

Once the MOs have been identified and the applicable SWOT analysis methodology applied to them has also been completed, these MOs could then be subdivided into lower level SOs (or subdivided even further), which will ensure that the MOs are reached in a satisfactory manner, as depicted in Fig. 6.

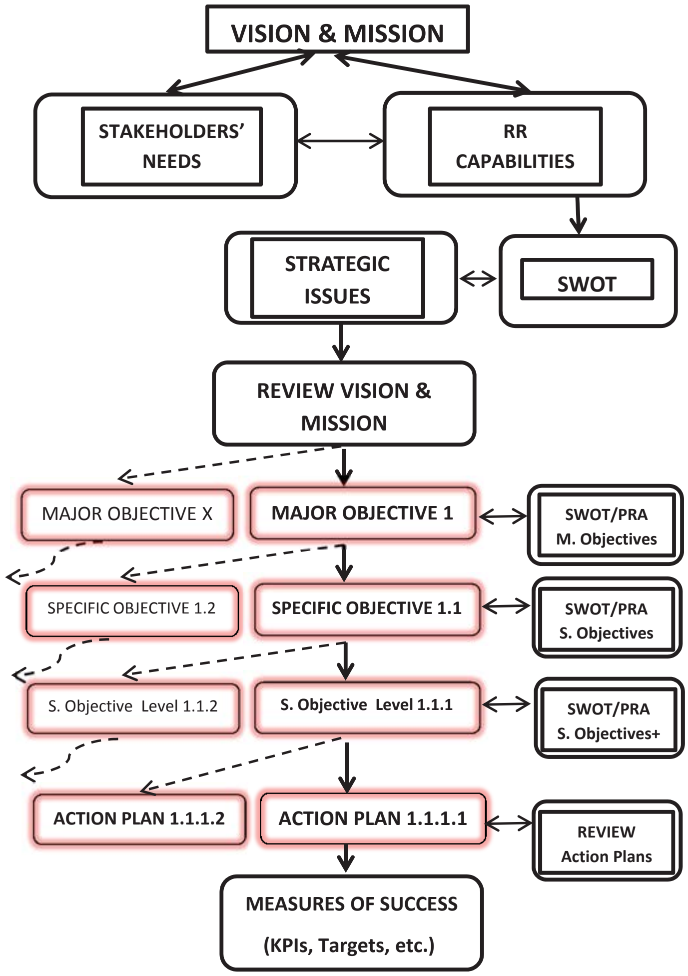

FIG. 6. Cascades of major objectives, specific objectives and action plans. KPI — key performance indicator; M. Objectives — major objectives; PRA — probabilistic risk assessment; S. Objectives — specific objectives; SWOT — strengths, weaknesses, opportunities and threats.

These SOs should answer the following questions based on the 'SMART' criteria:

— Are they *S*pecific enough?
— Can progress be *M*easurable for this objective?
— Is the objective *A*chievable?
— Is the objective *R*elevant?
— Can it be done in a *T*imely manner?

The cascading and iteration process, using the SWOT process described above, can now be applied to each level of SOs until the conclusions regarding activities to be performed are reached.

As an example, consider the MO above: 'To increase the level of utilization of the RR by the supply of irradiation products and services to stakeholders'. Some SOs that may arise are:

(i) To upgrade the collimation system in the tangential beam port to enable more effective use of the small angle neutron scattering facility by a specific date;
(ii) To increase the utilization hours of the neutron diffraction facility by academic institutions by 30% within 18 months;
(iii) To double the capacity of in-core irradiations of reactor materials within 1 year.

Each one of the above examples can then be broken down into lower level SOs as needed. As an example, a cascaded (lower level) SO of item (ii) could be to: ‘Initiate a marketing and outreach action involving academic institutions’. If considered necessary, this next level of SO can be broken down further into yet another lower level of SOs.

3.12. ACTION PLANS FOR SPECIFIC OBJECTIVES

Once the previous phase of the strategic planning is reached, it is appropriate to prepare APs that will detail, as much as possible, the tasks, responsibilities, resources and time schedule necessary to achieve each SO.

It is important that for each of these SOs, a responsible person be designated to manage the outcome and to have the authority and resources to complete the objective. A deadline for expected completion should be set by management, and regular reporting back should be required so that progress can be followed.

Each person responsible for an SO should ensure that important milestones are well identified on the time schedule and that formal reviews are included in the plan.

For each of these SOs, the following should be considered in the applicable APs:

- *Who?* The name of the person or group responsible for achieving this objective.
- *How?* Actions required to achieve the objective.
- *What?* A listing of resources needed, such as staff, equipment, supplies or money.
- *When?* A schedule that includes start and end dates and perhaps some intermediate milestones for a long project.
- *Priority?* An indication of the importance of each SO relative to others.
- *KPIs:* An indication of the mechanism to monitor and measure the effectiveness of the implementation (e.g. increased reactor utilization, client satisfaction or cost reduction (see Annex IV)).

The SP should contain only a summary of the detailed APs, in order to make the SP as simple as possible. In practice, the APs could be documented separately and referenced by the SP, to take into account considerations such as confidentiality.

In order to effectively implement the applicable actions, the person responsible for the SP should:

- Communicate with all staff who will be involved in actually doing the work. A detailed list of what needs to be done is required. An ERCR approach could be considered; see example in Annex V.
- Identify the most appropriate sequence for activities.
- Identify the resources required for each activity (e.g. people, budget, location and equipment).
- Show the activities on a time schedule.
- Communicate the review process and schedules to be applied.

Considering the earlier example, from the SO (ii) in Section 3.11.2:

> ‘To increase the utilization hours of the neutron diffraction facility by academic institutions by 30% within 18 months’

and a resulting lower level SO:

> ‘Initiate marketing and outreach action involving academic institutions’.

Typical specific AP steps that might arise are to:

(i) Prepare a marketing plan, including handout materials and a web site;
(ii) Organize a forum or workshop for potential new users;

(iii) Prepare and offer to give seminars on neutron diffraction applications to appropriate academic departments at various universities or industries;
(iv) Plan graduate level student experiments using the neutron diffraction system and offer them to the faculty of the university.

3.13. REVIEW AND STATUS REPORTING

As mentioned previously, the SP is a management document as well as a useful planning tool. It should therefore be regarded as a 'living document' to be reviewed and updated periodically or immediately if circumstances so dictate. At the same time, implementation of the various strategic items should be monitored for suitable progress against the applicable milestones set in the SOs and APs.

3.13.1. Progress reporting and feedback

The implementation of the final SP needs to be reviewed on an ongoing basis to ensure that its application is satisfactory and meets the operational requirements of the organization.

This section of the SP should include the control methods that will be applied by management during the application period. This applies to the specified methods of reporting required by the responsible persons (e.g. written and/or oral), the frequencies (e.g. monthly, quarterly and/or annually) and, if applicable, the person(s) responsible for authorization of the reports.

Progress reporting needs to be prepared based on measurable performance indicators (targeted and achieved) defined in advance (e.g. scheduling and costing limitations in APs). These are applicable to various levels of implementation such as facility performance, team performance and personal performance according to the expected indicators (KPIs).

The review or progress report may include success stories as well as failures experienced in implementing the actions. The structure of the organization or its processes that have an impact on the implementation of the SP should be considered.

Topics to be included in a progress report should correspond to the objectives and actions identified in the SP. Examples are:

— Operational achievements;
— Status of completion or achievement of APs or SOs;
— Finances;
— Levels of commercial or academic utilization;
— Safety (e.g. radiological, nuclear or conventional);
— Project progress.

3.13.2. Revision of the strategic plan

During the period of application of the SP, it is inevitable that feedback will initiate a need to change certain strategies/objectives. Review of the SP to evaluate its applicability should be done according to the frequency and methodology identified by the responsible management and the necessary revisions implemented in the document. Generally, this review should be done at least once a year.

Management must review the plan and the degree of success or failure of implementation of the APs and objectives, and assess the basis for eventual adjustment of those plans/objectives. The process is a logical step by step review of the MOs and SOs in accordance with the guidelines discussed earlier. This may involve re-evaluation of the objectives according to a SWOT approach.

3.14. ORGANIZATION AND PERSONNEL

The SP should carefully evaluate the personnel resources available to perform the various required activities. The responsible management should then consider allocation of the various tasks to personnel according to their present abilities and future potential. Special attention should be given to the consequences of staff attrition due to retirement and methods to ensure continuity of technical expertise.

3.14.1. Organizational structure

Although in most cases, the structures of an organization are already in place, the allocation of responsibilities should be carefully reconsidered in view of the strategies selected during the previous step in the preparation of the SP. This section of the SP should contain a quantified description of the various groups and their specific responsibilities, as well as their reporting lines to management (see the examples provided in Annexes VI and VII). This is easily represented with an organization chart.

The following categories, although not necessarily complete, are typical for a larger RR facility and should be considered during the establishment of an organizational structure with allocated responsibilities. For smaller facilities, the personnel involvement might not warrant this level of organization, and many of these functions may be fulfilled by two or three people. The human resources available should be addressed for all components of an RR facility, for example:

— Facility operations (e.g. shift operations, product loading and handling);
— Engineering (e.g. design, manufacture, installation and commissioning);
— Reactor utilization (e.g. client relations and contracts, operation scheduling and marketing);
— Maintenance (e.g. electrical, mechanical and instrumentation);
— Nuclear safety [8];
— Conventional safety (e.g. industrial);
— Nuclear fuel and material accountability;
— Personnel training (e.g. operators, quality assurance and emergency actions);
— (Integrated) (Quality) management system [9];
— Security;
— Environment;
— Property management;
— Finances;
— Other services (e.g. library services, administration and human resources).

3.14.2. Personnel development

Following the allocation of personnel responsibilities, the SP should identify the potential of personnel for further development. In particular, training in multifunctional abilities to ensure backup during absence, replacement of expertise owing to staff turnover and continuity of operation should receive attention. An increasing concern of many facilities is the loss of expertise owing to natural causes, for example, retirement of older persons with significant amounts of experience. If this is a potential concern for the facility, it would be helpful to include an age histogram in the SP indicating the various categories in the organization (reactor operators, scientists and technical support staff). This should be considered in the SP, as training in preparation for replacement could involve extra personnel and costs, in addition to the required lead time.

The methods of evaluation of all levels of personnel performance (KPIs) and ability should preferably be established and communicated to staff. Creative suggestions and participation by staff in problem solving should be considered as a strong motivational incentive.

The following areas of personnel development could be considered:

— Technical training (e.g. nuclear applications, engineering and reactor modelling);
— Management training;
— Applications of quality assurance;

— Marketing;
— Nuclear safety;
— Conventional safety (e.g. industrial).

3.15. FINANCING

The impact of suitable financial management of a facility is very often the major driver for reassessment of an RR facility's strategy. Consideration of the intended objectives and the financial implications must be addressed in such a case.

In many cases, the modified focus of the facility's strategy is driven by the need to satisfy a major stakeholder, for example that the operational management of the facility includes sound financial controls; basically, this means balancing the books to meet the funding resources.

In this section of the SP, the financial requirements for the implementation and operation of the facility's SP should be defined (e.g. in a summary of budgeted income and expenditure for each fiscal year) according to the duration of the SP.

3.15.1. Expenditure

Budget information should be presented in a manner that clearly identifies where funds are being applied. Examples of expenditure items include:

— Personnel and related running costs (e.g. salaries and specific training needs);
— Fuel;
— Service provision (e.g. electricity, water, steam and gas);
— Maintenance;
— Modifications;
— R&D projects;
— Upgrades;
— Waste management;
— Decommissioning funds [10];
— Overheads;
— Costs of products and services, including running costs and price estimation.

The above topics are merely a summary of some relevant key points — several more may be needed for a complete financial plan for most RRs.

3.15.2. Income

Budget information should also be presented in a manner that identifies the origin of funds, for example, major stakeholder related financial support, or whether income is from other sources such as:

— Revenues from clients for services;
— Subsidies/grants;
— Financial assistance received through R&D projects;
— IAEA support;
— Donations;
— Isotope sales;
— Analytical services (sales);
— Radiation services (cost recovery);
— Training fees;
— Beam time revenues.

Depending on the relevance to stakeholders on the SP distribution list, classified or sensitive financial expenditure or income information can be edited out or alternatively presented as percentages or pie charts.

3.16. OUTREACH AND MARKETING

Awareness of the facility, including its role in the national strategy and the impact on its surroundings, is often not very high among stakeholders outside the facility. In such cases, the management and personnel must essentially realize that the task of increasing such stakeholder awareness by outreach and marketing must normally be performed by capable persons, usually directly connected to the facility.

The identification of stakeholders and their relevant needs is discussed in detail in Sections 2.3.2 and 3.5. This section of the SP considers the methods that may be employed to increase stakeholder awareness of the existence of the facility and the potential for attracting stakeholder utilization.

Although the concepts of outreach and marketing may appear similar, there are subtle differences that should be clarified in advance.

Outreach is communication and information sharing with the concept of raising awareness of existing services among sections of a society that might not otherwise be aware of, or have access to, those services. A key component of outreach is that the groups providing outreach are mobile, i.e. facility outreach staff goes to the locations where those in need are.

Marketing is the process of communicating the value of a product or service to clients, for the purpose of making that product or service available and attractive to them. This often involves the concept of 'better value for money' than a product or service currently being provided, or a product or service that is not available elsewhere. Marketing of an RR facility includes all activities for utilization and may include the potential for additional funding. It is the link between a society's requirements and its socioeconomic patterns of response.

An RR facility must develop a strategic outreach and marketing plan in order to continually engage all stakeholder groups. Coordinated communication activities support objectives by reinforcing the image of an RR and its mission. As part of this process, several steps are essential:

— *Assessing public opinion.* Public opinion regarding nuclear research should be assessed prior to any marketing strategy being developed and should be adjusted accordingly, depending on the results. If there is limited knowledge about the benefits of this technology, more resources should be allocated to advertising and education efforts.
— *Effectively conveying key benefits to society.* Using the methods that will most effectively reach the target population (e.g. the general public, media and government), the anticipated socioeconomic benefits that the RR facility will provide should be conveyed. Subsequently, a communications plan/advertising campaign that will distribute the key messages should be developed. It is essential to use non-technical language that the target audience will understand.
— *Long term strategy.* This should enable clear, consistent, effective communications for the entire lifetime of the project, to ensure that stakeholders (including the public, media, users and funding partners) are always informed and engaged.

3.16.1. Outreach approaches

The initial activity regarding a successful outreach programme involves identification of the stakeholders who can be classified as persons who are not necessarily familiar with, or who normally do not have access to, the existing or proposed facility. These may include:

— Government;
— Municipalities/local community;
— General public;
— Media;
— Industry;
— Regional/international organizations.

The task of outreach in the case of nuclear facilities is often sensitive and might involve increasing awareness of the impact of the existing or proposed new facility on society. This must be done in such a way that the target audience is convinced of the positive contribution of the facility to meeting the needs of the nation, and, at the same time, the typical nuclear fears of the general public are dismissed. This may be achieved by the use of:

— Media training;
— Outreach materials;
— Open house policies;
— Web sites;
— Colloquia and presentations.

3.16.2. Marketing methodologies

As defined above, marketing involves a selling or convincing technique that is used to persuade a potential stakeholder (referred to here as a ‘client’) that utilization of the products and services of the RR facility would be beneficial to them.

The task of marketing typically involves identifying the needs of such potential clients and, by means of direct interaction, demonstrating that the RR facility can provide them with better[11] products and services than they are getting elsewhere. Methods used for information gathering and distribution between the facility and potential clients could involve:

— Questionnaires (see the example in Annex III);
— Seminars;
— One to one discussions;
— Networking (by alumni, former employees, veterans, former clients, etc.);
— Market analysis;
— Competitor analysis;
— Optimization opportunities;
— Cost analysis and price setting;
— Return of revenues for running and investment costs;
— Profit/no profit assessments;
— Client satisfaction evaluation;
— Communication training;
— Business plans;
— Business teams.

In this publication, the actions of marketing will be regarded as those that relate to the recruitment of clients for the sale of commercial products and services, as well as to the promotional aspects that relate to the non-commercial recruitment of academic and other users for experimental applications. As the benefits of a successful marketing strategy are many, the RR facility management must be aware of the danger of offering too many options or going beyond its capabilities. Rather, one or two areas in which the facility really excels should be identified and concentrated on. Expansion to accommodate additional products or services can always be handled once the current abilities are well established and valuable experience obtained.

There are certain logical considerations to be taken into account by the RR facility before a marketing process and strategy can be initiated:

— Have you identified potential clients or users?
— Have you evaluated the market demand for your product or service?
— Is your product or service well defined and ready for client application (i.e. does it meet their required quality standards)? It is inadvisable to attempt to market a product or service of undefined quality.
— Have you identified the actual cost and selling price of the product or service?

[11] ‘Better’ is quantified in terms of quality, accuracy, delivery time, reliability, costs, etc.

— Do you have a professional person/team to conduct, or assist with, your marketing, promotion and sales campaign?
— Have you developed a selling strategy or approach?
— Have you prepared an information brochure or web page that will assist in the marketing of your product or service?
— Do you have the full technical ability to achieve the quantity and quality of production required for the successful implementation of the product or service for your client(s)?
— Do you need technical assistance in finalizing the quality status of your service or product?
— Have you considered involving a technical partner?
— Do you have a mechanism for obtaining client feedback?
— Have you carefully considered and evaluated what would entice a client to buy from you?
— Do you have anyone who can explain your techniques without jargon to non-specialists?
— Does your organization require full cost recovery?

The list below gives some reasons why clients might prefer one supplier over another:

— Problem solving approach;
— Quality of product or services;
— Consistency of quality;
— Complete service (from sample preparation to final results);
— Personal contact;
— Punctuality, or timeliness of delivery;
— Good client relations;
— Ability to deal with diversity;
— International Organization for Standardization (ISO) certification/accreditation or compliance with the Organisation for Economic Co-operation and Development's good manufacturing practice;
— Availability of and compliance with the drug master file;
— Proven technical know-how;
— Guaranteed delivery networks;
— Flexibility of supply quantities;
— Variety or group of products or services;
— Backup service (support of reliability);
— Environmentally acceptable practices;
— Compliance with local and international safety and quality standards;
— Competitive pricing/market penetration.

3.17. CHANGE MANAGEMENT

In some cases, the adaptation of a new or modified strategic direction for an RR facility may require a change in the mindset of management and personnel. An example might be to refocus activities from basic R&D to identified national needs such as education and training, nuclear power programme operator training, or the generation of income by providing irradiation services and products. Such adaptations to personnel daily routines and career expectations can be difficult and often need special attention.

In many cases, a large portion of the SP could include a new installation, upgrade or modification of existing facilities and equipment or a change of the mode of utilization. Some of these applications, for example, could result in, among others, changes to the facility's safety case and may require regulatory approval. In such a case, the changes should be well documented and traceable for continued safe operation as well as the safe utilization of the facility [11].

As change management is an approach to transitioning individuals, teams and organizations to a desired future state, the scope of change management will depend on the specific requirements and the management policies of an operating institute. In general, however, the following facility adaptations might need special attention:

— Management of safety issues to incorporate the modified facility's operational statuses [11], such as safety analysis reports, environmental impact assessment reports and emergency plans;
— Modification to facility specifications such as design basis documents and design requirements;
— Documents for design and fabrication such as design descriptions, design calculations and end of manufacturing report packages;
— Procedures for operation and maintenance, including possible additional personnel and training needs;
— The need for adaptation of a modified (integrated) (quality) management system [9] to accommodate possible services or product related requirements for clients;
— Guides for safety of RR experiments and utilization of RR ancillary facilities;
— The need to add/upgrade experimental facilities and the implication of subsequent design limitations.

In any case, the safety of the RR facility should never be overlooked or jeopardized under possible pressure to comply with commercially driven requests for operation.

Furthermore, change management often incorporates the processes, tools and techniques to be utilized for helping individuals make successful personal transitions resulting in the adoption and realization of change. It is thus possible that there will be a need to change the mindset of the staff involved, for example, when the strategy requires a change from fundamental research to applied services, or from best measurement capabilities towards optimized client needs and requirements (not necessarily of the highest achievable quality) [12].

It should be kept in mind that change management often requires management of the people side of change to achieve the required business outcome, for example, using often unfamiliar marketing and outreach methods as discussed above. In some cases, specialized staff may be needed to support the new mission focus and assist in change management.

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Annex I

STRATEGIC CONSIDERATIONS

As indicated in Section 3.10, after having evaluated the results of the strengths, weaknesses, opportunities and threats (SWOT) or alternative analyses for the applicable objectives (e.g. major or specific) and their subsequent levels, several considerations that can influence the facility's objectives may be identified.

In order to decide which of these strategic considerations should be taken into account in a strategic plan, the facility should preferably have the guidelines or requirements of the next higher level of management available for reference.

The evaluation of the facility's status and capabilities, together with the stakeholder requirements and an appropriate SWOT analysis, should result in the answer to the questions 'What can I do now?' and 'What should I do now?' In addition, it should also enable the preparation of the objectives.

The following examples are not an exhaustive list, but merely guidance for a selection of strategies.

I–1. FACILITY OPERATIONS AND MANAGEMENT

Depending on whether this is a new or existing facility, strategies may be needed for the justification of the operation and management of such a facility. In the case of an existing facility, for example, the continuation of or a change in the existing operation of the facility, in terms of power levels, schedules and number of operating staff may be examined.

The following questions may then arise:

- At what power levels and for what duration will you operate the facility?
- What factors limit your ability to efficiently utilize the facility (e.g. research versus irradiation services)?
- Do you have sufficient funds for continuous operation, including timely replacement of instruments, maintenance, consumables, etc.?
- Do you have sufficient fuel supplies for extended operation?
- Does your facility have sufficient waste management handling resources?
- Does your staff availability permit you to meet all the operational requirements (e.g. shifts)?
- Does the operation of your facility/equipment have regulatory safety limitations?
- Is there a need to review the safety culture of operating personnel?

I–2. STAKEHOLDER AND USER RELATIONS

One of the conclusions of the SWOT analysis may be that the stakeholder involvement is not yet at the desired level. As such, a dedicated strategy may be needed to address the issue. A more detailed clarification on the role of stakeholders and a marketing and outreach approach typically required here is given in Sections 3.5 and 3.16, respectively.

I–3. MARKETING

The evaluation of abilities should enable a determination as to whether or not the facility should attempt to enter into a competitive market with respect to certain commercial products or services:

- Do you have an established end-user market defined?
- Do you know who the major competitors in the commercial business are?
- Do you have a special product or service with which you could pursue the market?
- Are there areas of potential commercialization that you should develop?

— Do you have a feeling for the commercial viability of new products or services?
— Are there any legal restrictions or trade barriers to be considered before attempting to enter a specific product market?
— Do you have access to a trade organization for assistance?
— Do you have an established web site for marketing information?
— Do you have access to support services for financial or business evaluation?
— Is there something you can do cheaper, quicker or better than the identified competitors?

A detailed clarification of the marketing approach typically required is given in Section 3.16.

I–4. FINANCIAL MANAGEMENT

In certain instances, it may be necessary for the research reactor (RR) facility to generate some form of financial income to justify its operational expenditure. The degree to which these expenditures might need to be balanced against income will usually be specified in a directive from the facility's major stakeholders or funders. As an example, the government funder(s) might require the facility to generate an income of 30% of the operational expenditure.

Answers to the following questions could possibly contribute to shaping such a strategy:

— Do you have a method to recover costs from facility users for product, experiment or service provision?
— Do you have preferential fees for certain clients (e.g. do academic users pay and do the users contribute to the instrument upgrades)?
— Is there an opportunity for external sources to assist with your financial liabilities?
— Is it necessary for you to accurately know the various costs of operation of your facility?
— Who will pay for individual services (e.g. water, electricity supply, building hire, insurance and nuclear liability)?
— Will a return of revenue generated by products and irradiation services be available to cover facility running costs?
— Do personnel salaries and training form part of your operational expenses?
— Who pays for your fuel supply?
— Is there an asset depreciation responsibility for your facility (e.g. building and capital equipment cost recovery over a depreciation period)?
— Who pays for your facility's maintenance?
— Is the facility responsible for radioactive waste removal and spent fuel storage?
— Are you responsible for the provision of decommissioning and dismantling funds?

A detailed clarification of the financing approach typically required is given in Section 3.15.

I–5. MAINTENANCE

The status of a facility can normally be directly related to its age and the degree of utilization in the past. Maintenance requirements will be identified according to the condition of plant equipment and associated instrumentation. The facility may develop its maintenance strategy on the basis of the answers to the following questions:

— Do you have maintenance procedures that you implement for items important to safety?
— Do you have scheduled maintenance programmes, during either operation or shut down?
— Are you aware of the maintenance status of other components?
— What long term replacements do you need to consider?
— What regulatory improvements do you need to consider?

— Do you implement an in-service inspection programme?
— Do you have an adequate ageing management programme?

I–6. LICENSING AND REGULATION

These matters are defined by the authorities controlling the facility licence and should receive the necessary attention to ensure that the operation of the facility is not interrupted owing to either unsafe or irregular applications. As such, answers are needed to questions such as:

— Is your facility licensed?
— Do the licence and support documents reflect the correct status of the facility?
— Do you envisage any changes (e.g. upgrades, modifications or experiments) to the facility that will impact on the validity of your existing licence?
— Are there any specific limitations imposed by the regulatory body that require special attention or even modification of the facility, prior to expanding activities or utilization?
— Are there any frequencies of nuclear occurrences that need attention (e.g. are there a number of less severe events that can be prevented)?

I–7. QUALITY MANAGEMENT

It is advisable that an RR facility be operated in accordance with suitable quality assurance and quality control in a well established quality management system. Certification or accreditation of the management system for compliance with international standards (e.g. International Organization for Standardization (ISO) 9001, ISO/International Electrotechnical Commission (IEC) 17025 or Organisation for Economic Co-operation and Development good manufacturing practice) may sometimes be advisable or even be necessary for client related activities.

An integrated (quality) management system covering compliance with several international and IAEA safety standards is recommended. This ensures that the necessary operations are performed in a controlled and acceptable way, at the same time ensuring that client specifications are satisfied. The implementation of such a strategy requires answers to questions such as:

— Can you consistently meet the quality requirements of existing or potential clients?
— Do you have established operational procedures?
— Do you apply quality control to services and products?
— Is it desirable to participate in an international quality assurance programme?
— If you have a quality management system, are you monitoring its success (e.g. by audits)?
— Do you wish to receive certification or accreditation for compliance with international quality management standards (e.g. ISO 9001, ISO/IEC 17025, etc.)?

I–8. HEALTH, SAFETY AND ENVIRONMENT

A facility should be implementing procedures and policies to ensure conventional (industrial) safety conditions for personnel and the public. At the same time, health and environmental requirements should be taken into consideration. In certain cases, these requirements can be included in a facility’s integrated management system. Strategies may be modelled from answers to questions such as:

— Do you have an acceptable conventional (industrial) and fire safety programme?
— Do you implement these procedures and evaluate their efficiency (e.g. by audits)?

— Do you wish to receive accreditation for compliance with environmental standards (e.g. ISO 14000)?
— Is an integrated quality management system needed to incorporate health, safety and environment related aspects?

I–9. TECHNICAL COOPERATION AND INFORMATION EXCHANGE

It is often beneficial for a facility to have access to some form of external technical assistance in operation and a means to exchange information regarding experiences. This cooperation and information can be provided from various sources, for example, the IAEA, nuclear societies, RR networks/groups or individual facilities, both internal and external to your own institution. Technical information sharing with similar RR facilities, either regional or international, can often be very beneficial to overcome challenges in aspects such as:

— Operational and maintenance experiences;
— Ageing management;
— Personnel training;
— Regulatory matters;
— Client utilization opportunities.

As such, a cooperative strategy could require answers to these questions:

— Do you have access to (or are you part of) the IAEA databases such as the Research Reactor Database or the Research Reactor Ageing Database?
— Are you involved in inter-regional cooperation agreements such as RR coalitions and networks?
— Have you attempted to establish working relations with similar RR facilities?
— Are there applications of interest that you would like to develop but are unsure of?
— Have you considered joint venture agreements (commercial) with other facilities (e.g. for backup of products or services or for personnel exchange and training)?
— Have you considered involving an external technical support organization for operational and safety issues?

Annex II

EXAMPLE OF STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS ANALYSIS AND PROBABILISTIC RISK ASSESSMENT

II–1. INTRODUCTION

The outcome of the strengths, weaknesses, opportunities and threats (SWOT) analyses discussed in Section 3.8 of this publication can be further evaluated using various processes to determine the importance or priority ranking of the applicable major objectives (MOs) and specific objectives (SOs) and the desired sequence of the necessary actions required.

This annex considers probabilistic risk assessment (PRA) for such a methodology. The application of PRA is an extensive topic. However, for simplicity, the discussion of PRA here will be limited to an example applicable to the situation at a typical research reactor (RR) organization.

The following definitions are relevant to this discussion.

II–2. DEFINITIONS RELATING TO PROBABILISTIC RISK ASSESSMENT

Risk

Risk is a measure of the inability to achieve overall objectives within defined cost, schedule and technical constraints, and has two components:

— The probability of failing to achieve a particular outcome;
— The consequences/impacts of failing to achieve that outcome.

Risk event

Risk events are those events within a programme that, if they go wrong, could result in problems in the development, production and operation of the system.

Risk events should be defined to a level such that the risk and causes are understandable and can be accurately assessed in terms of probability/likelihood and consequence/impact to establish the level of risk.

Risk assessment

Risk assessment[1] is an evaluation of the identified risk events to determine the probability/likelihood of the events occurring and their consequences/impacts, to assign a risk rating based on the programme criteria and to prioritize the risks.

Probability/likelihood

For each risk identified, the probability/likelihood that the event will occur should be determined. As an example, the following five levels of probability/likelihood could be used:

(1) Remote;
(2) Unlikely;
(3) Likely;

[1] The term ‘risk assessment’ here is of general nature and should not be confused with the term ‘risk assessment’ defined in the IAEA Safety Glossary, where it is limited to the “Assessment of the **radiological** risks associated with normal operation and possible accidents involving a source or practice”.

(4) Highly likely;
(5) Near certainty.

Consequence/impact

For each risk identified, the following question must be answered: 'Should the event occur, what is the magnitude of the consequence/impact?' As an example, impact levels can be categorized as:

(a) Minimal or no impact;
(b) Some impact;
(c) Moderate impact;
(d) Major impact: delays but achieve milestone;
(e) Unacceptable: can't achieve milestone.

As an example, in an RR organization, impacts could be determined in the following four areas:

— Technical performance;
— Schedules;
— Costs;
— Effect on other groups.

Risk ratings

These are the values given to a risk event based on the analysis of the probability/likelihood and consequences/impacts of the event.

Risk ratings of 'low', 'moderate' or 'high' may then be assigned based on the following criteria:

Low risk: Little or no potential for increase in cost, disruption of schedule or degradation of performance. Actions within the scope of the planned programme and normal management attention should result in controlling the acceptable risk.

Moderate risk: May cause some increase in cost, disruption of schedule or degradation of performance. Special action and management attention may be required to handle the risk.

High risk: Likely to cause significant increase in cost, disruption of schedule or degradation of performance. Significant additional action and high priority management attention will be required to handle the risk.

Based on the above definitions, a risk assessment guide can be prepared using the levels of likelihood and consequence involved (see Tables II–1 and II–2).

TABLE II–1. LEVELS OF LIKELIHOOD AND CONSEQUENCE

Likelihood: will the event happen?	Consequence: if event should happen
1 — Remote	a — Minimal or no impact
2 — Unlikely	b — Some impact
3 — Likely	c — Moderate impact
4 — Highly likely	d — Major impact: delays but achieve milestone
5 — Near certainty	e — Unacceptable: can't achieve milestone

TABLE II–2. RISK ASSESSMENT GUIDE

	Risk					
Likelihood	5	M	M	H	H	H
	4	L	M	M	H	H
	3	L	L	M	M	H
	2	L	L	L	M	M
	1	L	L	L	L	M
		a	b	c	d	e
	Consequence					

Risk assessment actions:

High (H): Unacceptable; major disruption likely; different approach required; priority management
Moderate (M): Some disruption; different approach may be required; additional management attention may be needed
Low (L): Minimum impact; minimum oversight needed to ensure risk remains low

II–3. EXAMPLE OF PROBABILISTIC RISK ASSESSMENT APPLICATION

Let us take into consideration the SWOT analysis examples given in the main text of this publication (Sections 3.8 and 3.11) relating to an existing capability of a reactor and the desire to implement an MO such as:

'Increase the level of utilization of the RR by the supply of irradiation products and services to stakeholders'

and assume that, among others, the following SOs were to be established:

— Irradiation and production capabilities to provide ^{99}Mo from low enriched uranium target plates;
— Irradiation of 6 inch[2] silicon crystals to provide neutron transmutation doping (NTD) of Si to international clients;
— Irradiation of selected materials (e.g. TeO_2 for the production of ^{131}I for local clients).

If the outcome of the SWOT analysis is examined in terms of potential risk, then it would be necessary to address those two categories of SWOT related aspects that might lead to non-achievement of these objectives, i.e. those found under weaknesses and threats.

Following are a few (imaginary) possible items selected from these categories for, for example, the NTD of Si case:

Weaknesses:

1. Reactor vessel cannot house a rig for 6 inch Si ingots;
2. Thermal to fast flux ratio is not well defined;
3. Technical specialists available for rig design are limited;
4. Others.

Threats:

5. Advance funding for rig manufacture is problematic;
6. Licensing authorities not supportive of proposal;

[2] 1 inch = 2.54 cm

7. Staff not available for shift operation of the Si NTD rig;
8. Others.

The approach could then be to tabulate the various risk aspects as in Table II–3.

TABLE II–3. RISK ASSESSMENT FOR RESEARCH REACTOR UTILIZATION IMPROVEMENT

No.	Risk area	Risk	Risk description/detail	Corrective action and comments	Probability (1–10)	Impact (1–10)	Risk (1–10)
1	Reactor vessel and Si neutron transmutation doping rig	Cannot irradiate 6 inch neutron transmutation doping ingots	The research reactor vessel cannot accommodate larger than 4 inch Si ingots in existing available positions	Evaluate option to house rig in alternative positions, e.g. in research reactor pool	7	10	7.0
2	Research reactor flux ratio inadequate	Neutron transmutation doping product quality not satisfactory	Customer requirement of <5% lattice damage cannot be met	Consider options to improve the thermal to fast neutron (N_{th} to N_{fast}) ratio, e.g. install additional reflectors	8	7	5.6
3	Rig design and manufacture	Ability to design and manufacture rig in-house	Design and manufacturing facilities not readily available at research reactor	Reallocate priority of other design and manufacturing activities, or consider external specialists but expect additional costs	7	4	2.8

In the above example, the risk can be classified as ‘low’, ‘moderate’ or ‘high’ according to a suitable scale as in the example that was used in the theoretical approach above, namely:

L (1–4)	M (4–6)	H (>6)

The action plans can then be prepared according to the ranking of risk corresponding to the PRA approach.

Annex III

EXAMPLES OF SURVEYS OF STAKEHOLDERS AND USERS OF RESEARCH REACTORS

III–1. INTRODUCTION

The purpose of the guidelines presented below is to assist in encouraging organizations to conduct surveys in order to determine the capabilities and competencies of existing research reactors (RRs), to implement a first RR in a country or to enhance the utilization and increase capabilities of an already operational facility. These guidelines are to be used in conjunction with the specific questionnaires illustrated below that have been derived for the above mentioned purpose. The guidelines and questionnaires complement the terms of reference (TOR) that define the scope of work that a Member State has to undertake to meet this purpose. The full set of materials, namely TOR, guidelines and questionnaires can be obtained electronically from the IAEA[1] on request, in the form of working documents.

III–2. OUTLINE OF METHODOLOGY FOR CONDUCTING SURVEYS

III–2.1. General process

The process commences with a Member State nominating persons with the required qualifications and particular interests to be a member of a survey team (ST), typically coordinated by the RR promoting organization. The Member State will have to decide on the team size, but it should be representative of all present/future facility stakeholders with a strong interest in the eventual outcome. The ST will then identify, from within its members, individuals who will be responsible for carrying out the survey process.

The nominated person(s) from within the ST will have the responsibility to seek out organizations that will be targeted for the survey. Types of organizations have been identified in the TOR without specifically naming organizations.

Each targeted organization will be asked to nominate an organizational facilitator to cooperate with the ST in identifying individuals or groups within their organization that may be of interest to the ST in conducting the survey. The organizational facilitator may, in fact, be the person who can provide the information sought from the questionnaire, but generally it is expected that they will nominate others from within the organization. The process described above results in the collation of information obtained by the ST.

III–2.2. Questionnaires

Once the information on relevant organizations, organizational facilitators, identified persons and groups has been gathered and collated within the guideline tables, the process of data collection from these identified persons is achieved through the use of tailored questionnaires. Of course, the ST can adapt or modify these questionnaires according to their particular needs and the national situation/environment.

The ST should seek questionnaire responses from individuals and/or groups at the *personal level*. It is considered that non-face-to-face surveys may result in ‘averaged’ and most probably inaccurate responses. An interactive approach to data gathering should be possible if the ST has some general background knowledge of RR technology and/or applications.

III–2.2.1. Questionnaires on potential users and stakeholders of research reactors

This set of questions (also known as questionnaire 1) relates to potential users and stakeholders of RRs by identifying applications for which a potential user/stakeholder may have a need. The first column describes general applications of these facilities. More detailed examples of each application can be annexed to the questionnaire.

[1] www.iaea.org/OurWork/ST/NE/NEFW/Technical-Areas/RRS/home.html

Responses to the applications should be based on the end result of the application and not the way in which it is achieved.

The ST should establish the person(s) within the team who will conduct the survey for each location. The nominated person(s) from the ST should:

(1) Prepare a list of all targeted organizations to be surveyed (following the orientation given in the TOR) and establish organizational facilitators; see the example provided in Table III–1.

TABLE III–1. LIST OF POTENTIAL USER ORGANIZATIONS

Potential user organization	Organizational facilitator and position	Contact details
University of Member State	Prof. MMMMM	Address, email, telephone
FGH Petroleum	Mr./Ms. GGGGG	Address, email, telephone
BNM Mining	etc.	etc.
CDT Industry	etc.	etc.

(2) In collaboration with each organizational facilitator, identify relevant individuals, groups or authorities within the listed organization who will take part in the survey, see Table III–2.

TABLE III–2. LIST OF IDENTIFIED PERSONS/GROUPS WITHIN A POTENTIAL USER ORGANIZATION

Name of organization: University of Member State
Organizational facilitator: Prof. MMMMM

Identified person or group	Contact details
Electronics group	Dr. HHHHH, telephone 123456
Materials science faculty	Mr./Ms. BBBBB, email bbbb@xyz.com
Mr./Ms. ZZZZZ	Address, email, telephone

(3) Interview the identified persons using the prepared surveys (to collect relevant data as detailed in Table III–3), by:

(a) Personal review of identified individuals, their interests and the problems they are trying to solve with relevance to RR applications;
(b) Any other relevant means.

Table III–3 is an example of a detailed questionnaire on typical information that the ST needs to collect regarding potential RR users and stakeholders, their interests in specific applications of RRs, actual and potential future needs for RR products and services, etc.

TABLE III–3. QUESTIONNAIRE ON RESEARCH REACTOR APPLICATIONS OF POTENTIAL INTEREST FOR IDENTIFIED USERS/STAKEHOLDERS

Name and profile of organization:
Name and speciality of person being interviewed:
Interview location and date:
Name of person conducting the interview:

Description of typical research reactor applications[a]	How many persons are presently involved (or could possibly be involved in the future) in the same or a similar application within the organization? Alternatively, is the identified person or organization a potential user of this or a similar application, now or potentially in the future?	Why does this application have 'relative importance' to the person and/or organization? How important is it?	Comments
1. Teaching students about nuclear and reactor physics			
2. Teaching, training and preparing operators of future power nuclear reactors			
3. Teaching, training and preparing safety authority specialists			
4. Neutron activation analysis			
5. Production of the most common radioisotopes for medical and industrial use			
6. Materials research using neutron beams (neutron scattering)			
7. Tests and examination of structural materials/objects (or fuel) under irradiation			
8. Neutron radiography/tomography			
9. Silicon doping			
10. Gem colouration			
11. Neutron therapy (research or patient treatment)			
12. …			

[a] Further information can be found in the following publication: INTERNATIONAL ATOMIC ENERGY AGENCY, Applications of Research Reactors, IAEA Nuclear Energy Series No. NP-T-5.3, IAEA, Vienna (2014).

Additional questions related to the above table might require further analysis by the RR operating organization:

— If you have answered positively to point 4: are you aware that additionally you will need a laboratory dedicated to this activity?

— If you have answered positively to point 5: will you need a radioisotopes production plant or use the RR only to irradiate the targets?
— If you have answered positively to point 7: are you aware that you will need hot cells and the required equipment for postirradiation analysis?
— If you have answered positively to point 11: are you aware that additionally you will need a medical centre to ensure this activity?

The IAEA[1] has developed some additional questionnaires and corresponding guidelines to facilitate new RR projects or enhance capabilities of already operational RRs, namely:

— Questionnaires 2 and 3 relate to the human resources that would be required to acquire, construct and operate an RR. The first columns of these two tables briefly identify relevant competencies required to resource the facilities.
— Questionnaire 4 relates to infrastructure support, which is both the human and material resources available to support RR operations. The first column describes, in general terms, the capabilities that will be required.
— Questionnaire 5 relates to the legal, nuclear regulatory and physical security framework. The first column lists directly related and indirectly related activities that could be applied to the operation of an RR.

Each of these additional questionnaires also requires information identifying by whom, when and where each survey was conducted. As already mentioned above, the full set of materials (questionnaires and corresponding guidelines) can be obtained from the IAEA[1] on request in the form of working documents.

III–2.3. Analysis of collected data

The ST should review the collected data and analyse them based on the initially formulated TOR. In brief, potential users should be grouped and quantified according to:

— Involvement in a specific application, as identified in the questionnaires, as well as quantification of their needs (e.g. radioisotope production, multielemental analysis and materials research);
— Total number of persons involved in the particular application, sorted according to level of involvement.

The analysis of these data should identify the applications with the higher 'relative importance' and possibly the need to implement/refurbish an RR for specific applications that are not yet available in a Member State.

III–2.4. Draft report

The ST should then draft a report based on information collected during the survey and analysed according to the initially formulated guidelines.

The focus of the report is to ultimately provide information and evidence that will allow the decision makers within the Member State to decide if the RR is justified and the type of facility that would be appropriate to the identified stakeholder needs.

A Member State's decision should be based on the potential utilization of the proposed facility and the ability of the Member State to implement and operate these facilities in a safe and secure environment.

In the first draft of the report, the ST should identify what it considers as the strengths and weaknesses of the Member State infrastructure to implement/refurbish an RR.

A possible template/content for the draft questionnaire analysis report is provided below.

Introduction

The ST should describe the reasons for the preparation of the report.

Methodology

The ST should describe the methodology used in carrying out the survey and analysing the data.

Results

The results should reflect the number of potential users specifying the applications with the higher 'relative importance', and available Member State human resources and infrastructure support for acquisition, construction and operation of an RR (or refurbishment if the RR already exists). Where applicable, data should be presented in tables and/or graphs, and be as quantitative as possible.

Conclusion

The conclusion should detail the existing strengths and weaknesses, gaps and needs within the Member State, to assess the actual needs, justify and implement the first RR (or refurbishment if the RR already exists).

Annex IV

EXAMPLE OF KEY PERFORMANCE INDICATORS FOR RESEARCH REACTOR UTILIZATION

Table IV–1 is a typical example of the key performance indicators (KPIs) for evaluating research reactor (RR) utilization as well as for observing the time evolution in line with the implementation of the strategic plan. The reader should note that all the proposed variables can (and should) be measurable. Such a choice allows various analysis possibilities through establishing correlations (e.g. number of operating staff versus number of users or experiments) or performing mathematical operations (e.g. Si doping efficiency in kilograms per hour of operation).

It is also understood that each RR organization will develop its own KPIs, specific to its facility characteristics and defined monitoring objectives/priorities.

TABLE IV–1. RESEARCH REACTOR KEY PERFORMANCE INDICATORS

General RR data		
	Country	**Enter country name**
	RR name	**Enter RR name**
	RR IAEA code	**Enter RR IAEA code**
	RR power (kW)	**Enter RR power**
	RR status (e.g. operational or shutdown)	**Enter RR status**
	Administrator/manager	
	Email	
	Telephone	
	Address	

			Year	
A. Staff/users		**20xx**	**20xx**	**20xx**
A1	Number of operating staff			
A2	Total number of facility personnel			
A3	Number of internal users			
A4	Number of external users			
A5	…			

			Year	
B. Operations		**20xx**	**20xx**	**20xx**
B1	Total hours per day in operation			
B2	Total days per week in operation			
B3	Total weeks per year in operation			
B4	Total hours in operation per year			
B5	Total planned hours in operation per year			
B6	…			

			Year	
C. Utilization data		**20xx**	**20xx**	**20xx**
C1	Neutron flux monitoring operation hours			
C2	In-core irradiation (channels, rigs, loops, etc.) operation hours			
C3	Pool side irradiation operation hours			
C4	Pneumatic irradiation operation hours			
C5	Material irradiation operation hours			
C6	Radioisotope production operation hours			
C7	Neutron scattering operation hours			
C8	Neutron radiography operation hours			

TABLE IV–1. RESEARCH REACTOR KEY PERFORMANCE INDICATORS (cont.)

C9	Neutron activation analysis operation hours			
C10	NTD of Si irradiation operation hours			
C11	Gemstone irradiation operation hours			
C12	Student training/experiment operation hours			
C13	Operator training operation hours			
C14	General guided tour/visit operation hours			
C15	…			

			Year	
D. Utilization results		**20xx**	**20xx**	**20xx**
D1	Neutron flux monitoring, number of experiments			
D2	In-core irradiation, number of experiments			
D3	Pool side irradiation, number of experiments			
D4	Pneumatic irradiation, number of experiments			
D5	Material irradiation, number of experiments			
D6	Radioisotope production, total activity in GBq			
D7	Neutron scattering, number of experiments			
D8	Neutron radiography, number of experiments			
D9	Neutron activation analysis, number of samples			
D10	NTD of Si irradiation, mass in kg			
D11	Gemstone irradiation, mass in kg			
D12	Student training/experiments, number of experiments			
D13	Operator training, number of operators			
D14	General guided tours/visits, number of events			
D15	…			

			Year	
E. Shutdown and maintenance data		**20xx**	**20xx**	**20xx**
E1	Number of scheduled shutdowns			
E2	Scheduled shutdown hours			
E3	Number of unscheduled shutdowns			
E4	Unscheduled shutdown hours			
E5	Number of work permits issued			
E6	Number of preventive maintenance events			
E7	Number of failures detected during preventive maintenance			
E8	Number of corrective maintenance events			
E9	Operation hours lost due to corrective maintenance			
E10	…			

			Year	
F. QA/QC		**20xx**	**20xx**	**20xx**
F1	Number of peer reviews			
F2	Number of QA/QC audits			
F3	SP update (yes=1, no=0)			
F4	Publication of annual progress report (yes=1, no=0)			
F5	Number of internal publications (technical notes)			
F6	Number of publications in peer reviewed journals			
F7	Number of RR staff (re)certified or (re)trained			
F8	Number of MSc projects active or completed			
F9	Number of PhD projects active or completed			
F10	…			

TABLE IV–1. RESEARCH REACTOR KEY PERFORMANCE INDICATORS (cont.)

		Year	
G. Financial records (US $)	**20xx**	**20xx**	**20xx**
G1 Total annual budget			
G2 Operational costs including salaries			
G3 Operational costs excluding salaries			
G4 Revenue generated from NAA			
G5 Revenue generated from RI production			
G6 Revenue generated from other irradiation services			
G7 Revenue generated from R&D with industry/other stakeholders			
G8 Revenue generated from education and training programmes			
G9 Total fiscal year generated revenue			
G10 Support received from IAEA			
G11 …			

Note: NAA — neutron activation analysis; NTD — neutron transmutation doping; QA — quality assurance; QC — quality control; R&D — research and development; RI — radioisotope; RR — research reactor; SP — strategic plan.

Annex V

EXAMPLE OF ELIMINATE, REDUCE, CREATE AND RAISE ANALYSIS

The strengths, weaknesses, opportunities and threats analysis and probabilistic risk assessment analysis described in Section 3.8 and Annex II will generally provide the identification of internal situations and the external environment to be considered in the development of a strategic plan (SP).

The actions needed to achieve the respective goals identified from such an analysis, however, are not always clear. An eliminate, reduce, create and raise (ERCR)[1] analysis can sometimes be of assistance in setting out solutions. The concept of ERCR analysis is depicted in Fig. V–1.

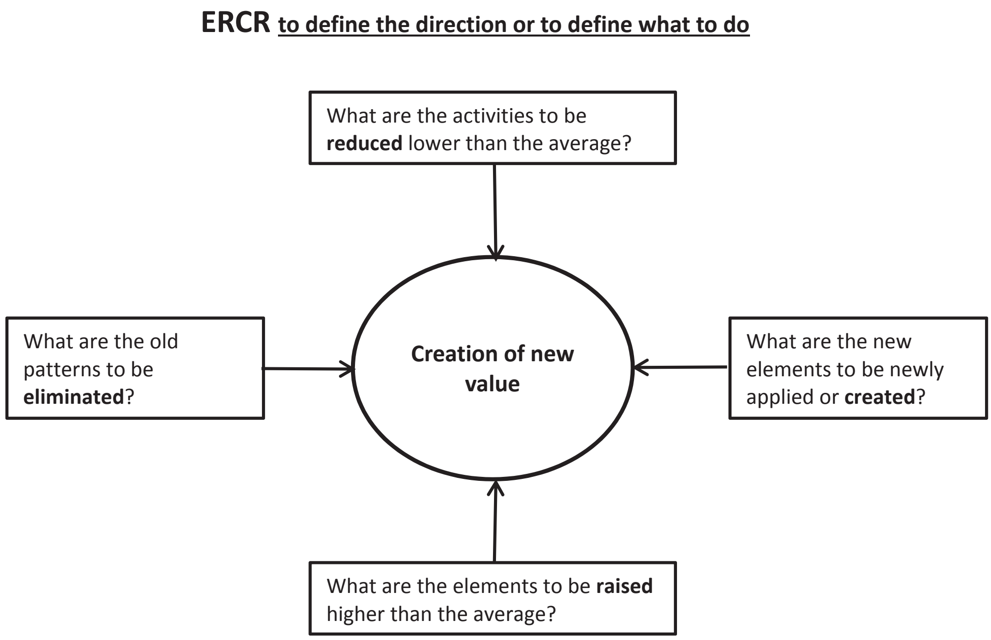

FIG. V–1. Concept of eliminate, reduce, create and raise (ERCR) analysis (adapted from Chan Kim and Mauborgne[1]).

[1] CHAN KIM, W., MAUBORGNE, R., Blue Ocean Strategy: How to Create Uncontested Market Space and Make Competition Irrelevant, Harvard Business School Press, Boston (2005).

A typical example of ERCR analysis is given in Table V–1, applied to the SP of the research reactor given in Annex VII.

TABLE V–1. EXAMPLE OF ELIMINATE, REDUCE, CREATE AND RAISE ANALYSIS, APPLIED TO A STRATEGIC PLAN

Eliminate	Reduce
To eliminate the use of high enriched uranium	To reduce the threats to funding by creating strong stakeholders To reduce the uncertainty in licensing activities by proposing a national regulatory framework
Create	**Raise**
To conduct core conversion to low enriched uranium To prepare an ageing management plan that will improve the system availability To conduct the replacement of an analogue control system To create a personnel management plan to resolve the undersized staff, high staff turnover and training issues To provide advice on nuclear matters to the government	To increase utilization of neutron activation analysis by using the facility's strengths in its location and its ability to offer complementary techniques and auxiliary facilities To increase the operation time by improving the cooling system To increase the radioisotope production and utilization capability To increase the teaching role in the university

Annex VI

EXAMPLE OF A STRATEGIC PLAN TEMPLATE

Annex VI is available electronically on the CD-ROM accompanying this publication.

The annex provides a proposed template for a research reactor strategic plan (SP), for an existing or a newly planned facility. The content of the SP is based on the details provided in Section 3.

Annex VII

EXAMPLE OF A TYPICAL STRATEGIC PLAN

Annex VII is available electronically on the CD-ROM accompanying this publication.

The annex illustrates a typical strategic plan (SP) document. However, this SP applies to a particular facility/institution and is an example only. Each facility will have to prepare its own SP to meet its particular objectives and needs.

ABBREVIATIONS

AP	action plan
ERCR	eliminate, reduce, create and raise
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
KPI	key performance indicator
MO	major objective
NTD	neutron transmutation doping
PRA	probabilistic risk assessment
R&D	research and development
RR	research reactor
SMART	specific, measurable, achievable, relevant and timely
SO	specific objective
SP	strategic plan
ST	survey team
SWOT	strengths, weaknesses, opportunities and threats
TOR	terms of reference
TSO	technical support organization

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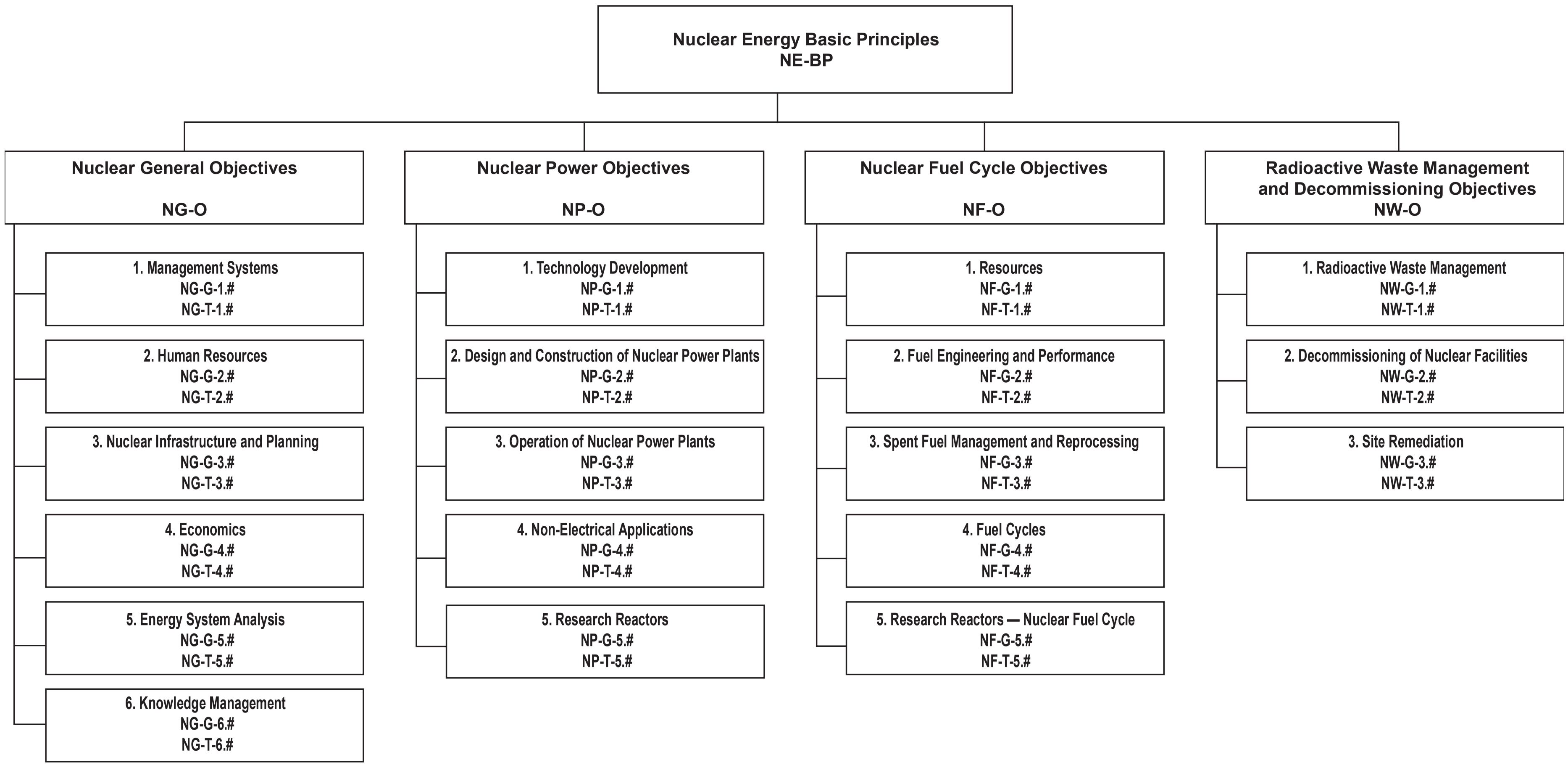

Key

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