

Program area Nuclear  
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## Strategy plan

# ENSRIC

## - Energiforsk Nuclear Safety Related Instrumentation and Control

Period: 2016-01-01 to 2018-12-31

### Summary

In the coming years a considerable amount of I&C systems and equipment must be replaced or upgraded because of different aspects of aging. This is a challenge and the experience from recent years is that the life cycle costs when introducing new digital platforms has turned out to be much higher than originally anticipated. The main focus of ENSRIC 2016-2018 will be to find cost- and time effective methods to extend the life time of the present analogue systems. A moderate estimation is that the investment cost for the renewal is in the order of 1 GSEK per reactor for F1-F3, R1-R2, O3 and OL1-OL2. Another focus area for the program is the asset management of the already installed digital platforms, finding time- and cost effective strategies for changes and updates.

ENSRIC will enable using international experience applied to a Nordic context, to assist the NPPs and authorities to take necessary decisions early in the process. It also constitutes an arena to discuss future I&C strategies for NPPs, authorities, researchers and vendors.

## 1 Vision

The vision of the nuclear I&C research within Energiforsk is that the activities should contribute to safe and robust I&C systems that promotes low Life Cycle Cost.

## 2 Benefits and deliverables

### 2.1 Receivers of expected benefits/deliverables

The ENSRIC results will contribute to the plant development process, including managers, strategic teams, analysts and implementation teams at the NPPs and at the authorities.

### 2.2 Expected benefits

The results obtained through ENSRIC will lead to a more time and cost efficient plant development process, both for the renewal of obsolete analogue equipment and for the asset management and development of already existing digital platforms.

### 2.3 Expected deliverables

- Guidelines for long term operation of obsolete analogue equipment.
- Guidelines for asset management of digital platforms based on previous experience.
- A common understanding if and how FPGA-based systems could be considered as a viable technology of choice in the light of the Nordic regulatory regime.

## 3 Focus areas and activity plan

The ENSRIC program consists of three program areas:

- LTO of existing analogue platforms
- Asset management of existing digital platforms
- Emerging technologies

The ENSRIC steering group suggest that activities are launched within all three program areas, but that the LTO-area will be the core area. The focus areas identified for 2016-2018 are:

### 3.1 LTO: Redesign/reengineering/refurbishment (RRR) of existing equipment

#### 3.1.1 Introduction

RRR is frequently used internationally to renew and modernize obsolete analogue equipment with similar technology and age compared to the Nordic plants. International experience indicate that this is a cost effective method, engineering and licensing efforts are reduced compared to replacing with another technology if system architecture and functions are kept the same. In order to analyse the opportunities for the Nordic NPPs, we need to utilize international

experience and identify opportunities, challenges and risks with use of RRR in the Nordic context.

In order to enable RRR it is also important to strengthen the cooperation with vendors and other actors, including actors that are not normally considered in Nordic NPP procurement.

### 3.1.2 Objectives:

Propose methods and guidelines for extending the expected life time of today well-functioning systems, retaining safety and high availability.

### 3.1.3 Activities

| <b>Activity</b>  | <b>Result</b>             |
|--|---------------------------|
| Refurbishment or reengineering – two methods of replacing obsolete equipment                       | Report                    |
| 1:1 cabinet exchange in Forsmark and Olkiluoto   | Comparative installations |
| International strategies - France  | Mapping                   |
| Strategies for RRR – international comparison  | Seminar                   |
| Legal issues, qualifications, procurement  | Mapping                   |
| Data bases for spare parts in a Nordic context, including methods for verification and validation. | Feasibility study         |
| Summary of findings on life cycle management and obsolescence                                      | Guide and seminar         |

## 3.2 Asset management: Process improvement

### 3.2.1 Introduction

Changes and asset management of programmable I&C and especially safety systems is, regardless of scope, very complex. The experience is that the continuous updating or modifications of the installed digital platforms systems are costly and time consuming both for NPPs and for the authorities. One costly and resource consuming effort is to show that the change has been implemented in a correct, complete and consistent way. A lot of the work is to demonstrate correct function, performance and that nothing else that shouldn't be affected has been affected by the change.

A mapping of how changes and asset management is handled today was carried out within the 2013-2015 phase of ENSRIC, and a number of suggestions on how to improve effectiveness – time, cost and quality - were identified. We would now like to continue this work and investigate if and how the suggested new strategies could be refined and implemented.

### 3.2.2 Objective

Identify a robust and cost effective process for changes and asset management of existing programmable platforms.

### 3.2.3 Activities

Only communication activities are planned for 2016. Possible further research activities will be discussed mid-2016.

| Activity   | Result   |
|--|--|
| Start a dialogue with NPPs/authorities regarding results from changes/asset management mapping study | Communication activities – workshops, seminars |
| International benchmark on changes/asset management of programmable platforms                        | International seminar                          |

## 3.3 Emerging technologies: Viability of Field Programmable Gate Arrays (FPGAs)<sup>1</sup>

### 3.3.1 Introduction

Previous work with FPGAs within ENSRIC indicate that a follow up study of licensing of FPGAs is needed to determine how they would be licensed in a Nordic context. In the U.S. the NRC have stated that FPGAs are licensed in the same way as software based products, which means that the expected time and cost reductions anticipated for licensing are significantly reduced. FPGA is however a technology that will be introduced in a number of areas and systems in the coming years, so they will most probably be introduced in systems that are installed in the NPPs regardless of our opinion on the technology.

### 3.3.2 Objective

Obtain further knowledge and understanding regarding needed verification and validation work to create and install the application into FPGA based products.

### 3.3.3 Activities

Only communication activities are planned for 2016. Possible further research activities will be discussed mid-2016.

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<sup>1</sup> A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by a customer or a designer after manufacturing – hence "field-programmable". FPGAs contain an array of programmable logic blocks that can be configured to perform complex functions. When this technology was introduced in the nuclear sector it was believed that it would be able to combine the flexibility of programmable software based designs and still be licensed similarly to analogue technology. Recent investigations however indicate that the licensing process is more complex and similar to that of software based design.

| <b>Activity</b>   | <b>Result</b> |
|---|---------------|
| International seminar on the latest developments within FPGAs in nuclear applications | Seminar       |

#### 4 Governance

The steering group consists of Anders Johansson Vattenfall (chairman), Fredrik Bengtsson Ringhals, Inge Pierre Svensk Energi, Karl-Erik Eriksson OKG, Markus Pyykönen Fortum, Mauri Viitasalo TVO, Niclas Larsson SSM, Roger Granath Forsmark, Stefan Persson SSM.