New Swedish regulations in the area of Plant Inspection and In-Service Inspection

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1 Introduction

In Sweden there has been a continues development of the regulations since 1956 when the first nuclear installations started to be designed. The first "regulations" were more like requirements for inspection of the pressure retaining components. In this continues developement of regulations there has been an important change of the degree of details in the last few years. The responsibility for the detailed interpretation and fulfilling of the regulations is today more clearly directed to the plant operator.

The development of the regulations has through the years also affected what kind of inspection organisations that are involved. Today we have a system with different accredited organisations for performing the inspections.

In my presentation I will focus on the development of the regulations up to now and how we are working with our new regulations. I will also describe the different organisations involved and how we up to now have managed to work according to the new regulation.

2 The history of the Swedish regulations

During the period when the older power plants were designed and constructed our regulator issued regulations that stated that there should be a certain amount of inspections and quality control done during the manufacturing of the components and also inspection programmes for the operation phase. The first kind of such regulation was issued already in 1956.

These first regulations stated also that the plant operator, the main manufacturers and suppliers quality programmes should be approved by the regulator and these quality programmes have to include requirements for design, manufacturing, installation and inspections. The regulator also issued at that time that In-Service Inspection programmes were required and that these programmes should be approved by an independent inspector. This inspector had the authority to decide what amount of third party inspection that should be performed.

In 1974 a new law was issued that introduced a system of "Riksprovplatser"(AB Statens Anläggningsprovning, SA). All third party inspections had to be performed by this company. The regulator issued new requirements 1975 as an effect of the above that clarified the amount of quality control that should be mandatory and performed by SA and what amount that could be performed by the other parties.

Some years later, in 1978, the first more complete regulations were issued by the regulator and these included general requirements for design, material, quality control and In-Service Inspection. There were also detailed requirement for manufacturing and installations. Requirements were included for assigning all components above safety classes as well as quality class, design class and inspection class. The later classes for guiding the amount of quality control. In 1980 the first revision was performed and at that date the new regulations became even more detailed and amount of inspections as well as methods and ways of reporting were in detail regulated.

In 1980 special requirements for In-Service Inspection were approved by the regulator. These requirements have been developed by a special working group with members from the regulator and the nuclear industry. Requirements for inspection of the reactor pressure vessel was based on ASME XI and for other pressure retaining components the normal Swedish Pressure Vessel Industry rules were the base.

Then in 1984 the regulator issued a new version of regulation (FTK) based on the former and in principal integrating the In-Service Inspection rules and some other specific requirements based on experience out of construction of the later errected nuclear power plants. The In-Service Inspection rules were not at that time updated in the same way as the other parts and therefore it was a great difference in degree of details between the different parts.

A new law was issued 1984 for the nuclear industry and with support of this the Swedish government gave the regulator mandate to make new revision of the regulations and this revision was finished in 1987 (FTKA). In this new regulation general demands for pressure retaining components were introduced and requirements for approval of design specifications for larger modifications from the regulator. The level of details in requirements was a little lower for the design and installation area. For In-Service Inspection the amount of inspections was now guided by a control group matrix, as shown below.

C I / F I	1	2	3	4	Extent of control
I	A	A	B	C	A: 75%
II	A	B	C	C	B: 10%
III	B	C	C	C	C: -

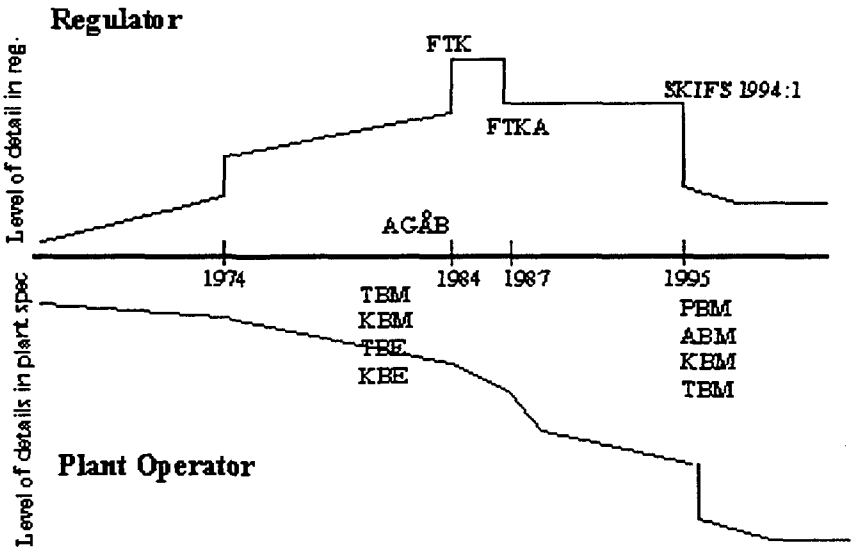
The In-Service Inspection efforts are concentrated to objects if a failure occurred, had the highest likelihood of causing core damage. The failure of pressurised components in a nuclear power plants can lead to situations of quite different safety importance depending on function it has in the process. The probabilistic structure serves as a conceptual framework

for the selection system. It proved however to be impossible for practical reasons to directly use probabilistic measures and instead the system was based on two engineering type measures, the failure index(FI) and the consequence index(CI). FI ranges from I to III and is an estimate of the failure propensity. CI ranges from 1 to 4 and is an estimate of the consequence. Based on assigned indices the objects (welds, T-joints, valves etc) are divided in control groups according to the table above.

In the regulations from 1987 also new requirements on NDT-techniques and NDT-personnel was introduced, these were coming out of experience from round-robin studies on NDT performance. Verified NDT-procedures on simulated but realistic flaws had to be approved by the official inspection agency(SA) and it was required that the NDT-personnel should pass a qualification test using the approved NDT-procedure on flawed samples.

In 1991 to 1993 the law was again changed and also EU-requirements lead to form a "open system" there the inspections and controls of the third party should be performed by "notified bodies". The regulator was here also directed to issue regulations in the same way as other regulators in Sweden. These directives lead to a total revision of the regulation and SKIFS 1994:1 was issued in September 1994 and valid from 1995-01-01.

SKIFS 1994:1 has a very low degree of detailed requirements and has as a appendix very general guidelines how to fulfil the requirements. It is the plant operators responsibility to specify in detail, and fulfil the requirements. The development of regulations has gone from requirements on quality system to very detailed requirements and ending today in very general regulations. A very clear responsibility is now given to the plant operator to specify the details and subsequently meet the prescriptive requirements. The development over this time period could be illustrated in the following way without any demand on exact level:



3 The regulation of today - SKIFFS 1994:1

In accordance with the law governing nuclear activities in Sweden the Swedish Nuclear Inspectorate issued the new regulations SKIFS 1994:1. These regulations cover pressure and load bearing components and other structural components in nuclear installations necessary to ensure:

- containment and cooling of nuclear fuel
- containment of radioactive material formed during the nuclear process
- maintenance of core geometry and shut down capability
- containment of nuclear material

These regulations are also applicable to other structural components which are connected to, or can affect, components necessary to ensure the above functions, and which belong to any of the control groups 1 - 4.

These regulations contain the following chapters:
Chapter 1 - Areas of application and definitions
Chapter 2 - Basic operating conditions, operational limitations, etc.
Chapter 3 - Regular inspection, monitoring and In-Service Inspection
Chapter 4 - Repairs, replacements, alternations and additions
Chapter 5 - Control of conformity and annual report
Chapter 6 - Other regulations
Attached to these regulations there are "General guidelines" that are general recommendations concerning the implementation of the mandatory requirements given. The recommendations should be regarded as minimum efforts to meet the requirements. Alternative actions can be taken if they present a conservative solution.

Then there are appendixes covering
App 1 - Guidelines for assessing damage and damage tolerance
App 2 - Guidelines for assigning inspection groups
App 3 - Guidelines for assessing the amount of inspection etc.
App 4 - Guidelines for qualification of non-destructive testing systems
App 5 - Guidelines for determining the necessary manufacturing and installation inspection

3.1 Summary of requirements in the different chapters

The regulations are specifying the requirements in a concentrated way without giving detailed requirements. It is the responsibility of the Plant operator to evaluate the requirements and specify detailed requirements.

Chapter 1 - Areas of application and definitions

In this chapter it is specified areas were the regulations apply and also areas where they do not apply. Definitions are given for terms used in the regulations.

Chapter 2 - Basic conditions for use, operational limitations, etc.

The basic conditions for structural components are specified and how to act when pressure and temperature fluctuations exceeds those that form the basis for design. Here is also specified that the Plant Operator should have a suitable inspection organisation.

Chapter 3 - Regular inspection, monitoring and In-Service Inspection

Here the assignment to inspection groups are directed and then also the amount of inspection of the reactor vessel and internals as well as other components. Supporting documents, inspection methods and qualification of inspection systems are directed. Directives are also given for what kind of report that should be given and how they should be certified.
In the guidelines for this chapter a modified matrix for assigning inspection groups was introduced, with some modified guidelines for determine Consequence Index and Damage Index:

Consequence Index / Damage Index	1	2	3
I	A	A	B
II	A	B	C
III	B	C	C

Chapter 4 - Repairs, replacements, alternations and additions

The assignment to safety categories of structural components is directed for setting the design requirements and quality assurance requirements for repairs, and for the manufacture and installation of replacement components, and components intended for use in modifications.
Directives are given here for:

- Repairs
- Design, manufacture and installation
- Examination of repairs, design, manufacture and installation
- Measures after installation

Chapter 5 - Control of conformity and annual report

The control of conformity is here specified, like for an example that the examination of supporting documentation for In-Service Inspection should be performed by an accredited inspection body. The accredited inspection body should in principal examine the fulfilness of the requirements in the regulation for the In-Service Inspection, functional tests, repairs, manufacture, installation and so on. After doing this the accredited inspection body must determine if a certificate of conformity can be issued. The certificate of conformity is required before start up of the plant.
Violations against these requirements could be, if serious, a matter that should be handled in court.
Directives are also here given to the plant operator to summarise such observations made during normally monitoring that have relevance for assessing the safety of component types, design or structural material. This should be included in an annual report to the Swedish Plant Inspectorate, as well as new experience that could affect the safety assessment and how it apply to the inspection programme.

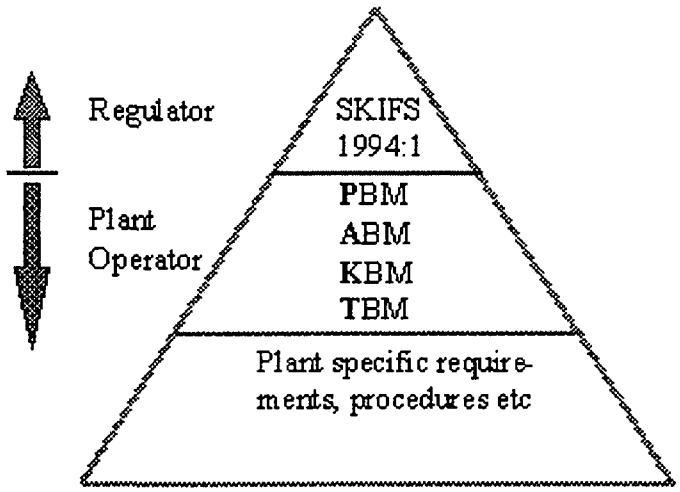
Chapter 6 - Other regulations
Here is specified the relations to other regulations and when this regulation should be implemented.

4 The Nuclear Industry response and development of practices

In the end of 1994 the Swedish Nuclear Industry started a project to assess the requirement in the regulation and make common detailed requirements for the nuclear industry. The project had a governing board with representatives from all Swedish Nuclear power plants and the members in the project group were coming from the plants. This project had four subprojects:

- General requirements
- Technical requirements
- Quality Control requirements
- In-Service Inspection requirements

The objective for this project was to issue documents that could be used as a base and "industry standard" for the development of plant specific documents.



In the middle of 1995 these documents were issued after an intensive work in the project and also out at the plants. Plant personnel made an examination and scrutinised all document. Totally about 80 persons were in some way involved in the work.
The basic requirements for the Swedish Qualification Center were also specified by the project as well as structure, organisation and the needed competence of the personnel that should be employed in the Center.

5 Organisations involved for the fulfilnes of demands

Organisations involved for the fulfilness of the requirements have to work in an "open" system according to Swedish laws(are in harmony with EU-regulations). The different organisation have different roles and act on order from the plant operator. These organisation have either to be approved or accredited.

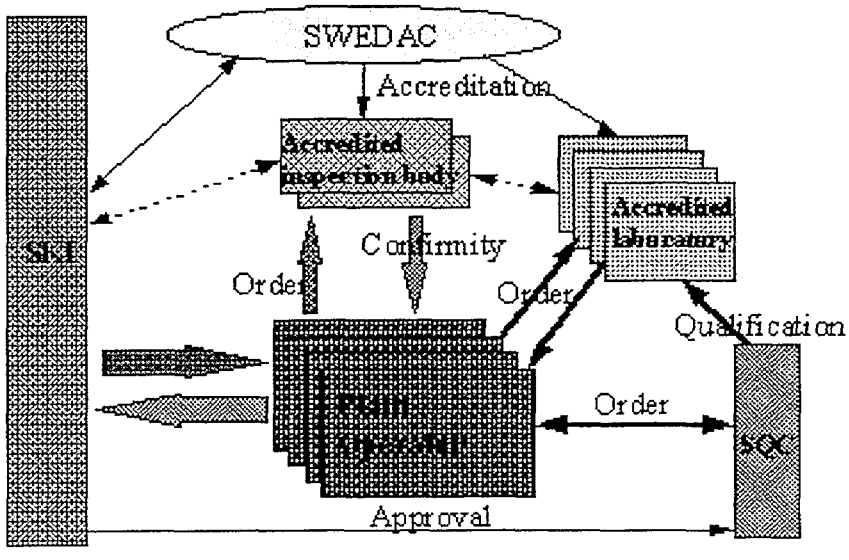
Swedish Board for Technical Accreditation - SWEDAC
In Sweden we have a special organisation that performs the accreditation of organisations that have to be accredited to perform there mission. This organisation has an authority status and the nuclear industry was to some extent new for them, they had before been involved in certifying In-Service Inspection personnel that performed inspection of pipes where IGSCC could be suspected. The requirements for being accredited were set up by the Swedish Nuclear Inspectorate and SWEDAC.

Accredited inspection body (third party status)
Organisation which, through accreditation for the entire category 1 in accordance with the regulations concerning third party inspection bodies with third party status issued by the Swedish Board for Technical Accreditation, are deemed competent to perform independent technical inspection of structural components in or for nuclear installations and are deemed competent to assess qualifications and manufacturers.

Accredited laboratory
Organisation which, through accreditation, in accordance with the regulations governing accredited laboratories issued by the Swedish Board for Technical Accreditation, are deemed competent to perform testing of structural components in or for nuclear installations.

Swedish Qualification Center
Independent national qualification body, owned by the Swedish Nuclear Power Plants, for qualification of In-service Inspection systems used for inspections in inspection group A and B. This special body has to be approved for the purpose by the Swedish Nuclear Power Inspectorate. In order to be approved the body must have an independent and impartial position, and a suitable organisation and necessary technical competence for the purpose.

Relations between the organisations
As mention before the plant operator has the full responsibility for the fulfilnees of all the mandatory requirements in the new regulations and the relations could be described as below.



The Plant Operator has to order the services from the accredited organisations and they have to work in accordance with the regulations. The Plant Operator has to fulfil the requirements and report to the Plant Nuclear Power Inspectorate as stated in the regulations.

6 Qualification of In-Service Inspection systems

In-Service Inspection of the reactor pressure vessel and parts in inspection groups A and B must be performed by using inspection methods which have been qualified to reliably detect and characterise and correctly determine the size of the damage which can occur in the specific type of component. Such qualification must be supervised and assessed by a special body approved by the Swedish Nuclear Power Inspectorate. In Sweden we have formed this body in our Swedish Qualification Center, SQC.
The requirements accepts the use of technical justifications together with practical demonstrations. The demonstrations applies to all NDE techniques.

7 Experience so far

In the beginning there were and in some cases still exists difficulties to find the right interfaces between the working organisations, but there have been improvements and the new relations are developing. The workload on the organisations are high and the Plant Operators have employed more personnel to there organisations working with the fulfilment of the requirements. Due to underestimation of needed competence and resources the process of implementation has taken longer time than estimated.

There has also been difficulties due to that it has been hard to comply with new requirements on upgraded design specifications as:
- new initiating events, new loads - dynamic/seismic
- results in hardware modification
- detection targets for ISI based on fracture mechanical calculations, time consuming and costly.

The qualification process has to some extent been unfamiliar and some experiences so far:
- requirement of defect specifications based on fracture mechanics
- needs NDE experts to compile existing information
- produce test samples in large scale
- heavy workload on the qualification center

and difficulties to meet implementation dates set by the regulator due to large efforts needed.

The summary conclusion is that the concept of the new regulation is good and the way of giving responsibility to the Plant Operator to form organisations and to fulfil requirements following the "Swedish Model" is good. Problems all always coming up in the beginning when introducing new systems and in this case there has been an underestimation of needed efforts to implement the regulations. The new regulation and changes in the different organisations roles has caused a movement of personnel between organisations and there has also been a need to employ new personnel to the organisations and to train them.