



The use of Commercial Grade Dedication in Sweden

Energiforsk
Industry standard components in nuclear I&C applications
22/10-2019

Nordic Nuclear Standard - Background

- Nordic reactors built in 70 – 80'ies
- A Nordic (US-flavor) industry standard was formed, PAKT



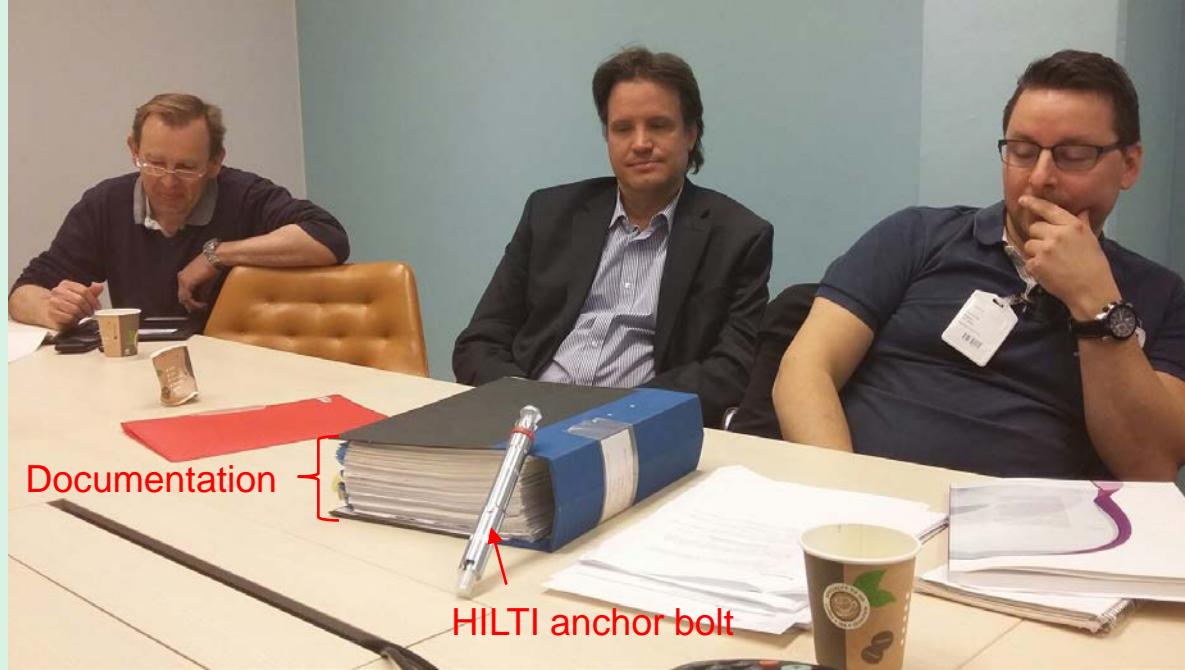
VATTENFALL

Architect Engineer

Industry Suppliers
"PAKT" standard

ASEA

Motivation Heavy Qualification Processes



Question: In what way could we simplify the additional paperwork and maintain nuclear safety?

Cost-efficiency of nuclear power can be improved



- A car, ca. 30 000 components
- Several electronic systems and mechanical components that contribute to safety
- **Price incl. taxes 19 000 €**

64 x



- Bolts and nuts for flanged connection of pipes
- Safety class 2
- **Price excl. taxes ca. 20 000 €**
- Off the shelf without certificates, ca. 160 €

- Qualification of an individual cable fitting: 250 000 €
- Design basis specification for a simple component: 250 000 €
- Qualification of software for a protective relay: 1 000 000 €

Motivation - Supply Chains

- The obsolescence question:
 - Components might become obsolete
 - Unqualified suppliers doesn't offer
 - Fewer qualified suppliers

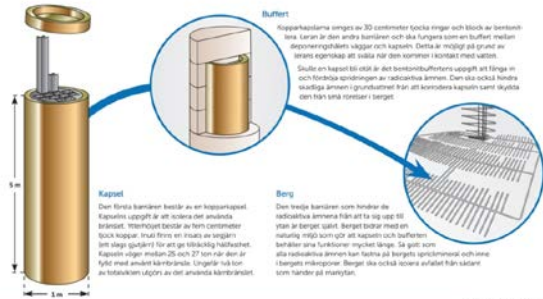
By accepting non-nuclear quality assurance standards, a large supplier pool becomes available for supporting replacements of nuclear components.

Motivation – New Plants CLINK

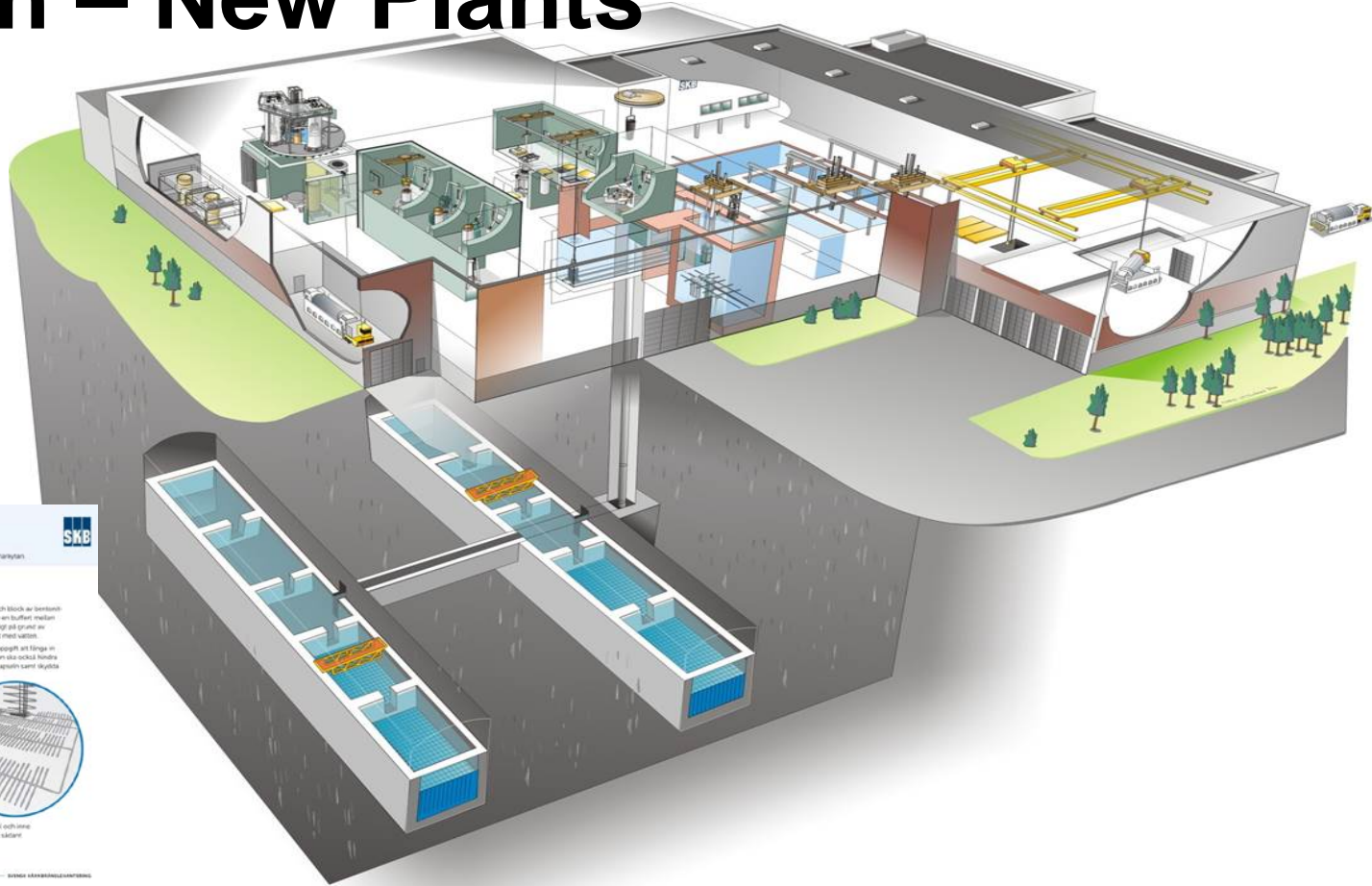
Encapsulation Plant for Final Storage

SKB's metod, KBS-3

Tre bärare – kapseln, bufferten och berget – ska tillsammans hindra de radioaktiva ämnena i det använda kärnbränslet från att ta sig upp till miljön.



SKB:s KÄRNBÄRINGSMETOD



Status – “Swedish Project”

On going activities	Schedule
Forsmark pilot project, SC-2 isolation valve	Completed
SKB pilot, diesel engine	Spring 2020
Pilot, A “new” qualification body, including data base infrastructure	2020/21
Work on “PAKT” Swedish qualification documentation	Planning stage
Pilot for programmable I&C, 61508	Planning stage
FORATOM - Supply Chain Optimisation	On-going. Positions 2019/20
EU - Modernisation & Optimisation of European Nuclear Supply Chain	On-going.

Forsmark Pilot Project

- SC-2, DN50 Isolation Valve qualified by API¹
 - 3rd party review by TÜV
- Shows a possible 40% cost reduction
- 4 suppliers
 - One supplier did not accept the conditions
 - One couldn't comply with CE-marking
 - One pre-qualified supplier offered a 4 times higher price
- Overall a successful result: It's possible to enter a real implementation!

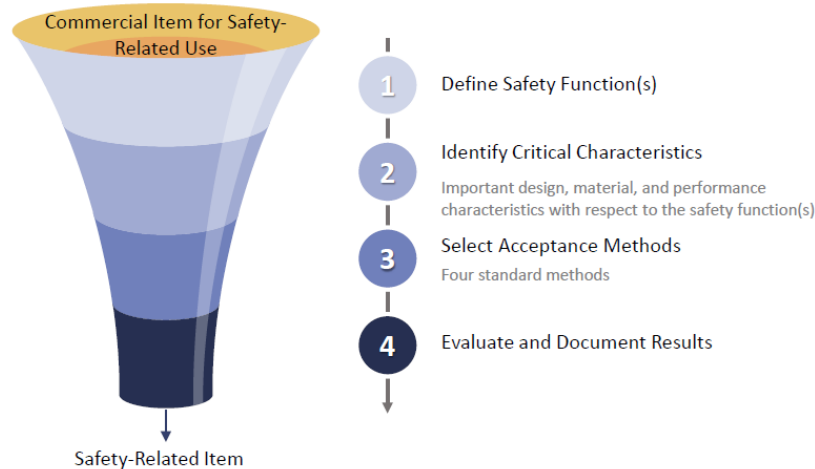
Forsmark Pilot - Isolation valve, SC-2

Item	Nuclear Grade	Commercial Grade
Quality Control	NQA-1, 10CFR50, App B	ISO 9001, API, etc
Third party qualification	YES	TüV
Materials	Material (steel) specifications: SS(1.4571) etc Well documented characteristics required General restrictions on Cobalt, Silver, Antimony, aluminum & zinc alloys, etc.	SS (F304) ASME API Check
Welding	Qualified against ISO or/and ASME	API 6D, ISO
Design requirements	ASME	API 6D
Pressure testing	ASME	API 598
Leak tightness	ASME	API 598
Pressure retaining	ASME	API 598
Seismic	<ul style="list-style-type: none"> - Seismic qualification - Weight Assessment 	<ul style="list-style-type: none"> - No - Weight assessment needed
Environment Qualification	Not needed in this case	No

Commercial-Grade Dedication

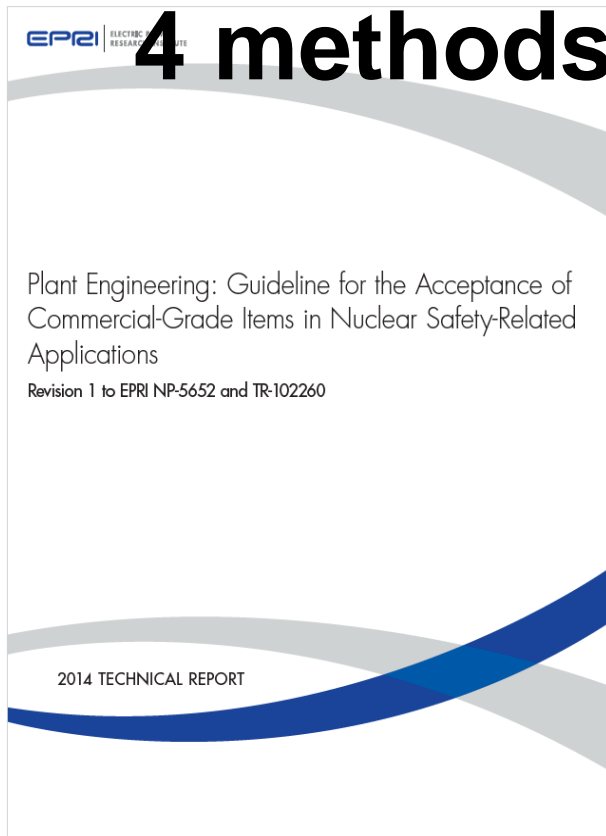
10 CFR 21: An Acceptance Process

“To look for an alternative acceptance process to provide reasonable assurance that a commercial grade item will perform its intended safety function”



Commercial-Grade Dedication

4 methods



Selected approach is item specific

1. Testing items on delivery
2. Inspection of supplier quality controls, i.e. ISO, API, Loyds
3. Inspection of the product line of the item
4. Documented record of historical data (in combination of 1-3)

Functional Safety is Everywhere!

IEC 61508 SIL qualification:



Automotive

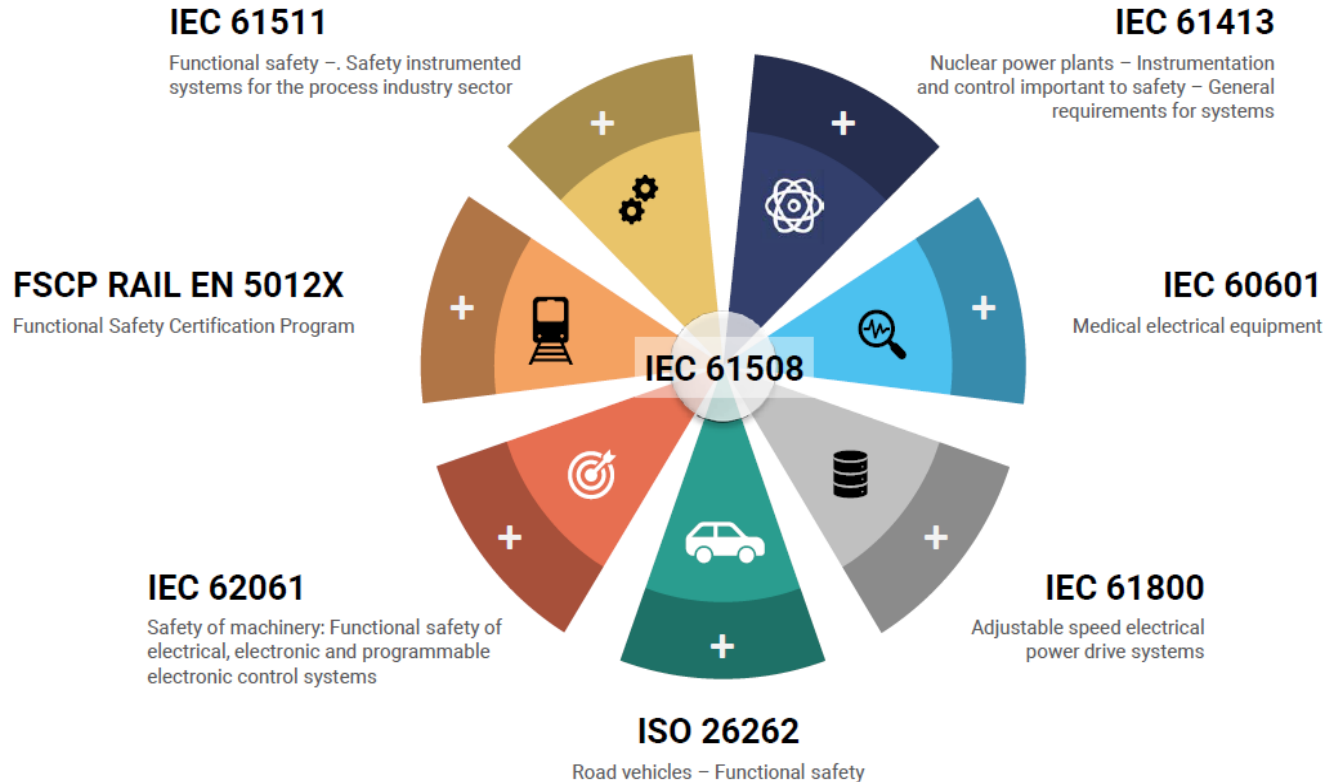


Transportation



Medical

I&C Industry-specific Standards





TÜV certified IEC/SIL3 Controllers



Independent HI Functionality



The Independent High Integrity system meets the same high level of quality and safety functionality as ABB's System 800xA High Integrity integrated safety system. The benefit is that it stands alone providing a physically and functionally segregated safety solution.

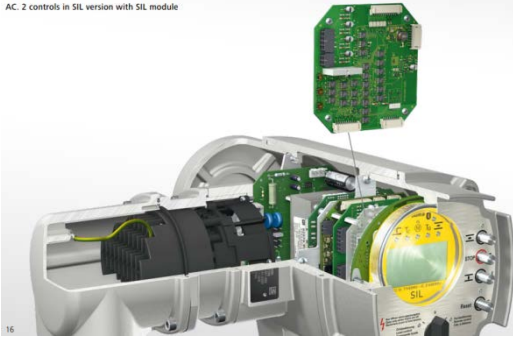


Safety by Quality and Design

SIL3 qualified valve operator

AC-2 INTEGRAL CONTROLS IN SIL VERSION

AC-2 controls in SIL version with SIL module



+

Nuclear Add-Ons

- Environmental qualification
- Robustness against hazards and disturbances
- Seismic assessment

System design, single failure

IMPROVING THE SIL CAPABILITY

Redundant system for Safe OPENING



Redundant system for Safe CLOSING



Simplified Seismic Qualification

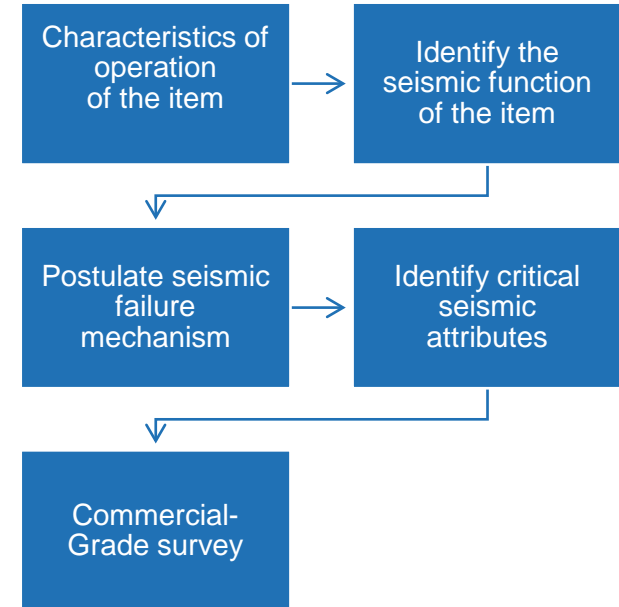
Seismic Savings Potentials

Indirect Methods for Alternative Suppliers' Components

+ The GIP methodology Seismic Qualification Utility Group

- + Can be applied to 20 "classes" of electric and mechanical equipment (e.g., pumps, valves, compressors, electrical cabinets, switchgear, and generators)
- + 33 members of SQUG, including 17 international operators (OKG, Vattenfall)
- + Deterministic approach **based on experience data** obtained from the performance of equipment during earthquakes, supplemented by shake table test data.
- + The SQUG method is also being applied for seismic qualification, design, and **procurement of new and replacement equipment** (NARE)

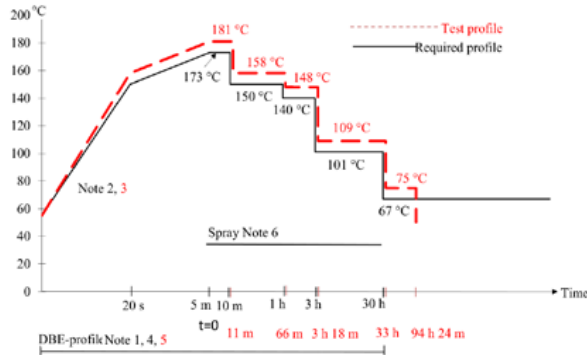
STERI - Seismic technical evaluation of replacement items
G-STERI - Generic seismic technical evaluation of replacement items
GIP - Generic Implementation Procedure
NARE - New and replacement equipment



Environment Qualification

- Qualifying an entire product family in one type test
- Reduction of Thermal Ageing Durations
- Joint EQ effort

APPENDIX 1



Sharing Data With Others

- We see that a future Nordic or European qualification body can
 - Store and share data with its members or on a cost share basis
 - Perform Qualification work

Durability Against Hazards

- Robustness and failure mode requirements
- Not a nuclear specific issue

Thank You!

Sweden - CO₂ emissions

