COMPILATION OF CONCRETE TEST DATA FROM THE NUCLEAR INDUSTRY

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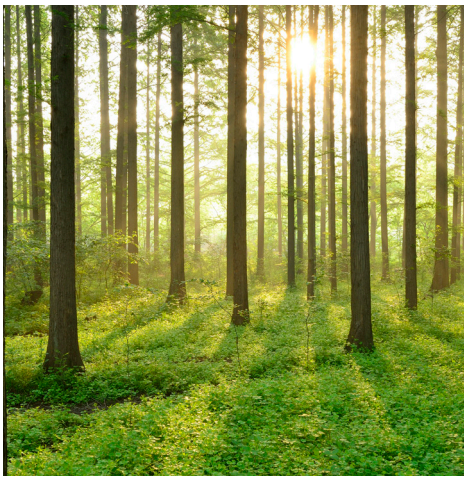

BETONGTEKNIK KÄRNKRAFT

NUCLEAR POWER CONCRETE TECHNOLOGY

Energiforsk

Compilation of Concrete Test Data from The Nuclear Industry

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Foreword

Testing of different material parameters in the concrete used in the nuclear power plants is done during construction and throughout the lifetime of the plant. In this project data from concrete testing in the Nordic nuclear power plants has been retrieved from reports and compiled in a table.

The data has been compiled and analyzed by Nick Zaraei and Peter Lundqvist, senior concrete experts at Vattenfall R&D. This project was carried out in the Energiforsk Nuclear Concrete Research Program, with stakeholders Vattenfall, Uniper/Sydkraft Nuclear, Fortum, Teollisuuden Voima Oy (TVO), Skellefteå Kraft, Karlstads Energi and the Swedish Radiation Safety Authority (SSM).

Sammanfattning

I föreliggande rapport har resultaten från mer än 200 olika provningar av betongs egenskaper som utförts i de svenska och finska kärnkraftverken sammanställts i en databas. Insamlandet av data utfördes genom sökningar i de digitala arkiven hos Forsmark och Ringhals och genom inrapporterad data från OKG och TVO i Finland. Syftet med sammanställningen är en omfattande databas med provningsdata som bl.a. ska kunna användas för att öka tillförlitligheten i teoretiska analyser och utvärderingar av kärntekniska betongkonstruktioner.

De vanligaste provningarna som utförts, och som utgör mer än hälften av de insamlade resultaten, är bestämning av betongens tryckhållfasthet och kloridinträngning. Övriga provningar som utförts är bl.a. mätning av karbonatiseringsdjup, spräckhållfasthet och analyser av tunnslipsprovkroppar.

Sammanställningen visade att den absoluta majoriteten av de insamlade provningsresultaten inte är utvärderade utan endast resultaten från provningen redovisas. För att t.ex. resultaten från bestämning av betongens tryckhållfasthet ska kunna användas i t.ex. analyser av en betongkonstruktions mekaniska beteende måste provningsresultaten utvärderas. Denna utvärdering syftar till att bestämma den karakteristiska tryckhållfastheten samt bestämma tryckhållfasthetsklass.

Summary

In this project an effort has been made to collect and compile results from various concrete testing performed at the nuclear power plants Ringhals, Oskarshamn and Forsmark in Sweden and Olkiluoto in Finland. In total results from 215 tests have been compiled performed during different time periods from the construction phase until recently. Approximately half of the compiled data regards tests for determining the compressive strength of the concrete and analyzing the chlorides contents in the concrete. Other types of tests are e.g. determination of carbonation depths, water penetration depth and analysis of thin sections.

The majority of the test data has not been evaluated in the original reports, therefore only results directly from the tests have been compiled. As a consequence the data cannot be used directly in theoretical analyses. Example of an evaluation method is the standardized procedure for determining the characteristic strength and concrete strength class.

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1 Introduction

1.1 BACKGROUND

The most important safety structures in a nuclear power plant, e.g. reactor containment, reactor building and cooling water ways are all concrete structures. In order to maintain a high level of structural reliability and safety, theoretical analyses and investigations along with upgrades are continuously being performed. When needed, e.g. in case of damages or degradations, repairs and refurbishments are also performed on a regular basis. Theoretical analyses of e.g. load bearing capacity of a concrete structure are based on the nominal properties of the concrete. However, the accuracy and reliability of structural analyses can be improved by using the real concrete properties, obtained from testing of the studied structure, as input. In addition, detailed information regarding the properties or status of the structure obtained from testing is important input for e.g. damage investigations and vital for choosing the appropriate countermeasures.

Starting as quality controls during the construction of the power plants and later as part of investigations of observed degradations and damages a huge amount of tests of different concrete properties have been performed at the different power plants. The testing is in most cases performed on cores extracted from the investigated concrete structure. Common types of testing are e.g. compressive strength, chloride content and carbonation depth. However, no compilation of the data or database containing the results from these tests exists. A compilation of the results from all tests into a database would be of great benefit to the nuclear industry in Finland and Sweden as basis for increasing the accuracy and reliability of future analyses and investigations. In this project an effort is made to collect and compile results from testing performed at the nuclear power plants Ringhals, Oskarshamn and Forsmark in Sweden and Olkiluoto in Finland.

1.2 PURPOSE AND GOAL OF THE PROJECT

The purpose of this project is to collect and compile existing information on concrete tests regarding compressive strength and other properties like chloride contents, carbonation depth, etc. for the nuclear power plants (NPP) Forsmark, Ringhals and OKG in Sweden and Olkiluto in Finland.

The goal of the project is a database containing data from all the material tests that has been performed on extracted concrete samples from the Swedish and Finnish nuclear power plants.

1.3 LIMITATIONS

Since the nuclear power plants in general do not have processed and collected documentation, it is very possible that this compilation is not exhaustive.

2 Collection and compilation of test data

The collection of information was performed with searches in the digital archives of Forsmark (FKA) and Ringhals (RAB) and compilation of data that was sent from OKG in Oskarshamn and TVO in Olkiluoto. All the obtained data has been compiled into one database. Only information regarding security classed buildings have been included in the compilation.

The compilation consists of data about type of test and test results, but also including additional information e.g. location, dimensions of samples, number of samples, year, the name of company that have performed the tests, properties of samples and documentation.

Each separate test series, e.g. samples extracted simultaneously from the same structure, are presented together in one row in the database. The values of the tested physical properties are e.g. presented as mean value and/or as the range of the values.

3 Results and discussion

In appendix 1 the results of the compilation are presented. In total results from 215 tests have been compiled performed during different time periods from the construction phase until recently. Approximately half of the compiled data regards tests for determining the compressive strength of the concrete and analyzing the chlorides contents in the concrete. Other types of tests are e.g. determination of carbonation depths, water penetration depth and analysis of thin sections. The most common types of samples are cores extracted from various locations in the structures see Figure 3-1. However, for tests of the compressive strength precast cubic samples have also been used.

Figure 3-1. Concrete cores extracted from a concrete structure in Forsmark NPP.

To the authors knowledge the vast majority of the compressive strength test results have not been evaluated in the original reports from which the data have been extracted. Therefore only data directly from the tests are presented in this compilation. In order to be able to use the data from compressive strength tests in structural analyses the data must be evaluated and the appropriate concrete strength class must be determined. Procedure for this evaluation can be found in the European code SS-EN 13791 [1], which involves determining the characteristic compressive strength of samples at specific locations or for the structure as a whole and also assign a compressive strength class to the concrete.

The compiled data lack more detailed information from each presented test series, i.e. only mean value or the range of the values are presented. In order to be able to perform a more detailed analysis or evaluation of the data, e.g. as described above, each separate test value must be known. Alternatively at least the mean value, range and standard deviation from each tests series should be available.

Evaluation of the results from the other tests e.g. chloride content and carbonation depth, should also be evaluated. This would give an overview on the status of chloride contents and carbonation depth in nuclear concrete structures. The evaluated data could also be used for increasing the accuracy of calculations of chloride diffusion and carbonation of nuclear concrete structures. In addition, information regarding the environmental exposure for the structure from which the samples were extracted, e.g. below or above the waterline, should be added to the data regarding chloride content in the concrete.

Even though the compilation is based on a comprehensive search in the digital archives, it is very possible that additional test data exist in the nuclear power plants report archives. For example the majority of the data obtained from TVO only contains information regarding the type of test but lacks the actual results from the tests. A more extensive compilation from all power plants should therefore be performed in order to achieve a complete data base.

4 Conclusions

The following can be concluded from the compiled data:

- The most common types of tests that have been performed are determination of chloride content in the concrete and assessment of the compressive strength.
- The majority of the test data has not been evaluated in the original reports, therefore only raw data has been compiled. As a consequence the data cannot be used directly in theoretical analyses. Example of an evaluation method is the standardized procedure for determining the characteristic strength and concrete strength class.
- The compiled data lack more detailed information from each presented test series, i.e. only mean value or the range of the values are presented. In order to be able to e.g. evaluate the data, e.g. as described above, each separate test value must be known.

5 Future work

Based on the results from the compilation the following further work is proposed:

- The compilation of test data presented in this report is unfortunately not exhaustive. A more comprehensive compilation of test data from all powerplants should be performed.
- The data in this report and any additional compiled data should be evaluated and analyzed, e.g. compressive strength data should be evaluated so it can be used in theoretical analyses.

6 References

[1] SS-EN 13791:2019, Assessment of in-situ compressive strength in structures and precast concrete components.

7 Appendix 1 Test results

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
FKA	F1	Inneslutning	Tryckhållfasthet	Gjutetapp enligt rit. 1-902907	1973 -75	K35, K40, K50	Prov per gjutetapp, enligt F-0113240	Kub 150x150x150	Statensvatten-verk Forsmarks-arbetena	Redovisat per etapp, enligt F-0113240	Not evaluated	?	F-0113240 och i Pärmar i Forsmarks arkiv	
FKA	F1	Intagsbyggnad	Tryckhållfasthet	Silgata A60	2006	?	6	Kub 100x100x100	VRD	78 Mpa	Not evaluated	SS-EN 12390-3 SS 137214	EXT-2006-2230	
FKA	F1	Intagsbyggnad	Vatteninträgning	Silgata A60	2006	?	6	Kub 100x100x100	VRD	10 mm	Not evaluated	SS-EN 12390-3 SS 137214	EXT-2006-2230	
FKA	F1	Intagsbyggnad	Vidhäftningshållfast het (sprutbetong)	Silgata A70 (sprutbetong)	2006	?	5	72	VRD	1,1 Mpa	Not evaluated	Friktionsgrepp enligt SS 137243	EXT-2006-2176	
FKA	F1	Intagsbyggnad	Vidhäftningshållfast het (sprutbetong)	Silgata A40	2005	?	3	?	VRD	0,54; 0,74; 1,98 Mpa	Not evaluated	Friktionsgrepp enligt SS 137243	EXT-2005-1802	
FKA	F1	Intagsbyggnad	Tryckhållfasthet	Silgata A40	2005	?	3	Kub 100x100x100	VRD	67 Mpa	Not evaluated	SS-13 72 30 SS-13 72 34	EXT-2005-1802	
FKA	F1	Intagsbyggnad	Vatteninträgning	Silgata A40	2005	?	3	Kub 100x100x100	VRD	6,7 mm	Not evaluated	SS-13 72 30 SS-13 72 34	EXT-2005-1802	
FKA	F1	Intagsbyggnad	Kloridhalt	Silgata A40	2005	?	3	44	VRD	Min 0,05%; Max 1,32%	Not evaluated	RCT - method	EXT-2005-1523	
FKA	F1	Intagsbyggnad	Kloridhalt	Silgata A70	2006	?	5	66	VRD	Min 0,05%; Max 4,5%	Not evaluated	RCT - method	EXT-2006-1869 FMI-2015-0725	
FKA	F1	Intagsbyggnad	Kloridhalt	Silgata A10	2010	K30	8	96	VRD	Min 0,06%; Max 0,59%	Not evaluated	RCT - method	EXT-2010-1165	
FKA	F1	Intagsbyggnad	Tryckhållfasthet	Silgata A60	2008	?	7	104	VRD	61 Mpa	Not evaluated	SS-EN 12390-3	EXT-2008-3026	
FKA	F1	Intagsbyggnad	Tryckhållfasthet	Silgata A60	2009	?	3	100	VRD	85 Mpa	Not evaluated	SS-13 72 20	EXT-2009-0322	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
FKA	F1	Kylvattenbyggnad kylvattenvägar	Kloridhalt	Pumpsump 10712P2	2008	?	8	100	CBI-Betonginstitut	Min 0,03%; Max 0,84%	Not evaluated	?	FM-2009-1051	
FKA	F1	Kylvattenbyggnad kylvattenvägar	Kloridhalt	Reservutlopp mellan AC Diesel	2008	?	6	100	CBI-Betonginstitut	Min 0,03%; Max 1,79%	Not evaluated	?	FM-2009-1051	
FKA	F1	Turbin 11, 12	Tryckhållfasthet	Valv	2010	?	36	750	VRD	53,5 Mpa (mean)	Not evaluated	SS-EN 12390-3	EXT-2010-5637	
FKA	F1	Turbin 11, 12	Tryckhållfasthet	Valv	2010	?	6	330	VRD	63,3 Mpa (mean)	Not evaluated	SS-EN 12390-3	EXT-2010-5637	
FKA	F1	?	Kloridhalt	Recirkulationsutlopp	2006	K30	6	95	VRD	Min 0,05%; Max 2,8%	Not evaluated	RCT - method	EXT-2006-1665	
FKA	F1	Kylvattenbyggnad	Kloridhalt	Utloppsschakt	2007	?	4	?	VRD	< 0,05 %	Not evaluated	RCT - method	EXT-2007-2070	
FKA	F1	Kylvattenbyggnad	Karbonatiserings-djup	Utloppsschakt	2007	?	4	?	VRD	15-20 mm	Not evaluated	SS 13 72 42	EXT-2007-2070	
FKA	F2	Inneslutning	Tryckhållfasthet	Gjutetapp, enligt rit. 1-926807	1975 -78	K35, K40, K50	Prov per gjutetapp, enligt F-0113241	Kub 150x150x150	Statensvatten-verk Forsmarks-arbetena	Redovisat per etapp, enligt F-0113241	Not evaluated	?	F-0113241 och i Pärmar i Forsmarks arkiv	
FKA	F2	Turbin 21, 22	Tryckhållfasthet	rum C02.09/10	2010	K30	11	94	VRD	65,1	C50/60	SS-EN 1379/SS-EN 12390-3	FT-2010-1153 EXT-2010-2302	
FKA	F2	Kylvattenbyggnad	Kloridhalt	Utloppsschakt	2009	?	9	96	VRD	Min 0,03%; Max 7,64%	Not evaluated	RCT - method	EXT-2009-4586 FM-2009-1225	
FKA	F2	Kylvattenbyggnad	Karbonatiserings-djup	Utloppsschakt	2009	?	9	96	VRD	0-2 mm (mean)	Not evaluated	SS 13 72 42	EXT-2009-4586 FM-2009-1225	
FKA	F2	Dieselbyggnad	Kloridhalt	Utloppsschakt	2008	?	3	105	VRD	Min 0,03%; Max 2,18%	Not evaluated	RCT - method	EXT-2008-2372 FM-2008-0850	
FKA	F2	?	Kloridhalt	?	2009	?	6	?	CBI	Min 0,12%; Max 4,38%	Not evaluated	CBI: metod 5.1195	EXT-2009-5076	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
FKA	F3	Inneslutning	Tryckhållfasthet	Gjutetapp, enligt rit. 1-944114-15	1980 -83	?	Prov per gjutetapp, enligt F-0113242	Kub 150x150x150	Statensvatten-verk Forsmarks-arbetena	Redovisat per etapp, enligt F-0113242	Not evaluated	?	F-0113242 och i Pärmar i Forsmarks arkiv	
FKA	F3	Intagsbyggnad	Tryckhållfasthet	Silgata	2011	?	3	Kub 90x90x90	VRD	55,5 Mpa	Not evaluated	SS-EN 12390-3	EXT-2011-5117	
FKA	F3	Kylvattenbyggnad Dieselbyggnad	Kloridhalt	Kylvattenvägar	2006	?	9	100	VRD	Min 0,05%; Max 1,5%	Not evaluated	RCT - method	EXT-2006-1519	
FKA	F3	Kylvattenbyggnad Dieselbyggnad	Karbonatiserings-djup	Kylvattenvägar	2006	?	9	100	VRD	0-10 mm (mean)	Not evaluated	SS 13 72 42	EXT-2006-1519	
FKA	F3	Tunnel	Kloridhalt (sprutbetong)	Konstruktionsdel L 7	2006	?	8	95	VRD	Min 0,2%; Max 3,55%	Not evaluated	RCT - method	EXT-2011-0984	
FKA	F3	Tunnel	Karbonatiserings-djup	Konstruktionsdel L 7	2006	?	8	95	VRD	3 mm	Not evaluated	SS 13 72 42	EXT-2011-0984	
FKA	F3	Kylvattenbyggnad Intagsbyggnad Tunnel	Kloridhalt	Konstruktionsdel L 1 & L 7	2006	?	25	95	VRD	Min 0,05%; Max 4,75%	Not evaluated	RCT - method	EXT-2011-0952 EXT-2006-1261	
FKA	F3	Kylvattenbyggnad Intagsbyggnad Tunnel	Karbonatiserings-djup	Konstruktionsdel L 1 & L 7	2006	?	25	95	VRD	1-10 mm (mean)	Not evaluated	SS 13 72 42	EXT-2011-0952 EXT-2006-1261	
RAB	R2	Inneslutningen	Spräckhållfasthet	Inneslutning Bottenplatta och vägg (invändigt)	2011	K400/K500	6	45	CBI-Betonginstitut	5,5 Mpa (mean)	Not evaluated	SS-EN 12390-6	DI:2158039	
RAB	R2	Inneslutningen	Kloridhalt	Inneslutning Bottenplatta och vägg (invändigt)	2011	K400/K500	6	45	CBI-Betonginstitut	Min 0,027%; Max 0,087%	Not evaluated	SP-metod 0433 (Rapid Cholride test)	DI:2158039	
RAB	R2	Inneslutningen	Analys av brandpåverkade betongkärnor	Golv +115-plan	2011	K400	4	45,5	CBI-Betonginstitut	Sprickfrekvens till ca 2 mm	Not evaluated	Ultraljud och ljusmikroskopi	DI:2158043	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
RAB	R2	Dieselbyggnad	Kloridhalt	Dränagevatten-kassunen	2011	K250(?)	32	45	CBI-Betonginstitut	Min 0,03%; Max 0,79%	Not evaluated	CBI:metod 5.1995	DI:2158534	
RAB	R2	Turbinbyggnad	Kloridhalt	?	2011	K300(?)	11	45	CBI-Betonginstitut	Min 0,02%; Max 2,46%	Not evaluated	CBI:metod 5.1995	DI:2158535	
RAB	?	?	Kloridhalt	T11 - 446	2011	?	11	45	CBI-Betonginstitut	Min 0,02%; Max 0,07%	Not evaluated	CBI:metod 5.1995	DI:2182235	
RAB	R4	Inneslutningen	Kloridhalt	Cylindervägg	2012	K500	5	94	CBI-Betonginstitut	Min 0,02%; Max 0,35%	Not evaluated	SP-metod 0433 (Rapid Cholride test)	DI:2184473	
RAB	R4	Inneslutningen	Tryckhållfasthet	Cylindervägg	2012	K500	5	94	CBI-Betonginstitut	84,7-104,8 Mpa	Not evaluated	SS-EN 12390-3	DI:2184473	
RAB	R4	Inneslutningen	Spräckhållfasthet	Cylindervägg	2012	K500	5	94	CBI-Betonginstitut	4,4-5,5 Mpa	Not evaluated	SS-EN 12390-6	DI:2184473	
RAB	R4	Inneslutningen	Karbonatiserings-djup	Cylindervägg	2012	K500	5	94	CBI-Betonginstitut	0-1 mm	Not evaluated	SS- 13 72 42	DI:2184473	
RAB	?	?	Kloridhalt	T12 - 446	2012	?	24	45	CBI-Betonginstitut	Min 0,02%; Max 0,2%	Not evaluated	CBI: metod 5.1195	DI:2184862	
RAB	R1	?	Kloridhalt	Generaturfunda-ment G11	2012	?	16	45	CBI-Betonginstitut	Min 0,03%; Max 0,25%	Not evaluated	CBI: metod 5.1195	DI:2184864	
RAB	R1	Dieselbyggnad	Kloridhalt	DG 110	2012	K250(?)	6	45	CBI-Betonginstitut	Min 0,16%; Max 4,19%	Not evaluated	CBI: metod 5.1195	DI:2190713	
RAB	?	?	Kloridhalt	Kondensor 32-sida	2012	?	4	45	CBI-Betonginstitut	Min 1,14%; Max 12,29%	Not evaluated	CBI: metod 5.1195	DI:2190714	
RAB	?	?	Kloridhalt	Kondensor 41	2012	?	13	95	CBI-Betonginstitut	Min 0,03%; Max 21,12%	Not evaluated	CBI: metod 5.1195	DI:2190716	
RAB	R34	Kylvattenvägar	Kloridhalt	Svallschakt	2012	K300(?)	6	45	CBI-Betonginstitut	Min 0,09%; Max 2,47%	Not evaluated	CBI: metod 5.1195	DI:2191930	
RAB	R2	?	Kloridhalt	?	2012	?	4	45	CBI-Betonginstitut	Min 0,98%; Max 40,06%	Not evaluated	CBI: metod 5.1195	DI:2194390	
RAB	R2	?	Kloridhalt	?	2012	?	4	45	CBI-Betonginstitut	Min 0,27%; Max 19,07%	Not evaluated	CBI: metod 5.1195	DI:2194394	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
RAB	R2	?	Kloridhalt	715-kassun	2012	?	7	45	CBI-Betonginstitut	Min 0,03%; Max 0,86%	Not evaluated	CBI: metod 5.1195	DI:2196661	
RAB	R2	Transformatorbås	Kloridhalt	Bergrum mellan transformatorbås	2012	?	3	45	CBI-Betonginstitut	Min 0,04%; Max 0,18%	Not evaluated	CBI: metod 5.1195	DI:2201478	
RAB	R2	Turbin	Tryckhållfasthet	?	2012	K300(?)	53	45	CBI-Betonginstitut	Min 31,6 Max 103,0 Mpa	Not evaluated	SS-EN 12390-3 SS 13 72 07	DI:2221668	
RAB	R2	Turbin	Kloridhalt	?	2012	K300(?)	111	?	CBI-Betonginstitut	Min 0,02%; Max 1,55%	Not evaluated	CBI: metod 5.1195	DI:2222863	
RAB	R2	Turbin	Tryckhållfasthet	?	2012	K300(?)	4	45	CBI-Betonginstitut	Min 46,4 Max 76,0 Mpa	Not evaluated	SS-EN 12390-3 SS 13 72 07	DI:2234127	
RAB	R2	Turbinbyggnad	Kloridhalt	Dränageschakt	2011	K300(?)	95	45	CBI-Betonginstitut	Min 0,02%; Max 22,4%	Not evaluated	CBI: metod 5.1195	DI:2236778	
RAB	R4	Kylvattenvägar	Tryckhållfasthet	Dränageschakt 3 Utloppsstuds 40-172-L1	2013	K300(?)	15+12+14=41	45-95	CBI-Betonginstitut	Min 62,2 Max 88,7Mpa	C45/65 C60/75	SS-EN 12390-3 SS-EN 13791	DI:2250593	
RAB	R4	Kylvattenvägar	Kloridhalt	Dränageschakt 3 Utloppsstuds 40-172-L1	2013	K300(?)	41	45-95	CBI-Betonginstitut	Min 0,02%; Max 5,24%	Not evaluated	CBI: metod 5.1195	DI:2250593	
RAB	R4	Kylvattenvägar	Karbonatiserings-djup	Dränageschakt 3 Utloppsstuds 40-172-L1	2013	K300(?)	41	45-95	CBI-Betonginstitut	=< 1 mm	Not evaluated	SS- 13 72 42	DI:2250593	
RAB	R4	Kylvattenvägar	Tunnslip	Dränageschakt 3 Utloppsstuds 40-172-L1	2013	K300(?)	41	45-95	CBI-Betonginstitut	Se Bilaga 3	Utvärderi ng enligt Tabell 2 bilaga 3	Ljusmikroskopi	DI:2250593	
RAB	R2	Turbinbyggnad	Kloridhalt	Dränageschakt	2011	K300(?)	95	45	CBI-Betonginstitut	Min 0,02%; Max 22,4%	Not evaluated	CBI: metod 5.1195	DI:2236778	
RAB	RG	Videbergs hamn	Kloridhalt	?	2013	?	17	?	CBI-Betonginstitut	3,63%; 6,63%	Not evaluated	CBI: metod 5.1195	DI:2251636	
RAB	R2	Turbinbyggnad	Kloridhalt	Dränageschakt	2014	K300(?)	2	?	CBI-Betonginstitut	Min 0,15%; Max 6,55%	Not evaluated	CBI: metod 5.1195	DI:2266833	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
RAB	R3	Kylvattenvägar	Tryckhållfasthet	Betongtunnel Dränschakt R3-D5 Utloppsstuds R3-U6 Dränschakt R3-D2 Dränschakt R3-D3	2014	K300(?)	13 + 11 + 11 + 14 + 17 = 66	45-73	CBI-Betonginstitut	Min 73,8 Max 87,4; Min 50,1 Max 55,1; Min 47,8 Max 75,6 ; Min 61,1 Max 101,7; Min 53,4 Max 81,7 Mpa	C60/75 C45/55 C45/55 C35/45 C45/55	SS-EN 12390-3 SS-EN 13791	DI:2266834	
RAB	R3	Kylvattenvägar	Kloridhalt	Betongtunnel Dränschakt R3-D5 Utloppsstuds R3-U6 Dränschakt R3-D2 Dränschakt R3-D3	2014	K300(?)	66	45-73	CBI-Betonginstitut	Min 0,29 Max 4,56; Min 0,02 Max 3,57; Min 0,63 Max 2,68 ; Min 0,02 Max 0,76; Min 0,03 Max 2,48 %	-	CBI: metod 5.1195	DI:2266834	
RAB	R3	Kylvattenvägar	Karbonatiserings-djup	Betongtunnel Dränschakt R3-D5 Utloppsstuds R3-U6 Dränschakt R3-D2 Dränschakt R3-D3	2014	K300(?)	66	45-73	CBI-Betonginstitut	Max 31; Min < 1 mm	-	SS- 13 72 42	DI:2266834	
RAB	R3	Kylvattenvägar	Tunnslip	Betongtunnel Dränschakt R3-D5 Utloppsstuds R3-U6 Dränschakt R3-D2 Dränschakt R3-D3	2014	K300(?)	4	45-73	CBI-Betonginstitut	Se Bilaga 3	Utvärderi ng enligt Tabell 3 bilaga 3	Ljusmikroskopi	DI:2266834	
RAB	R2	Inneslutningen	Kloridhalt	Bottenplatta	2014	K350	4	30 och 50	CBI-Betonginstitut	Min 0,02 Max 0,04 %	-	CBI: metod 5.1195	DI:2306309	
RAB	R2	Inneslutningen	Tryckhållfasthet	Bottenplatta	2014	K350	4	ca 80	CBI-Betonginstitut	Min 61,3 Max 81,3 Mpa	Not evaluated	SS-EN 12390-3	DI:2310905	
RAB	R2	Inneslutningen	Tryckhållfasthet	Bottenplatta	2014	K350	3	ca 80	CBI-Betonginstitut	Min 81,3 Max 89,5 Mpa	Not evaluated	SS-EN 12390-3	DI:2310906	
RAB	R2	Bränslebyggnad	Tryckhållfasthet	runt bränslebassäng	2014	K300/K350	4	45	CBI-Betonginstitut	Min 55,0 Max 97,4 Mpa	Not evaluated	SS-EN 12390-3	DI:2313736	
RAB	R2	Bränslebyggnad	Kloridhalt	runt bränslebassäng	2014	K300/K350	7	45	CBI-Betonginstitut	Min 0,03 Max 0,06 %	Not evaluated	SS-EN 12390-3	DI:2313736	

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RAB	R2	Bränslebyggnad	Tunnslip	runt bränslebassäng	2014	K300/K350	7	45	CBI-Betonginstitut	Se Bilaga 2	Utvärdering enligt Tabell bilaga 2	Polarisationsmikroskopi	DI:2313736	
RAB	R2	Inneslutningen	Tunnslip	Bottenplatta under tätplåt	2014	K350	2	45	CBI-Betonginstitut	Se tabell 1-3	Se tabell 1-3	Ljusmikroskopi	DI:2321297	
RAB	R2	Inneslutningen	Tryckhållfasthet	?	2014	K350	2	kub 45x45	CBI-Betonginstitut	44,2 och 45,2 Mpa	Not evaluated	SS-EN 12390-3 SS 13 70 03	DI:2333115	
RAB	R2	Inneslutningen	Tryckhållfasthet	?	2014	K350	2	kub 150x150	CBI-Betonginstitut	39,9 och 41,5 Mpa	Not evaluated	SS-EN 12390-3 SS 13 70 03	DI:2333128	
RAB	R1	Inneslutningen	Kloridhalt	Koniska delen	2017	K40 och K50	3	45	CBI-Betonginstitut	Min 0,02 Max 0,05 %	-	CBI: metod 5.1195	DI:2413538 Bilaga 1	
RAB	R1	Inneslutningen	Tryckhållfasthet	Koniska delen	2017	K40 och K50	2	96	CBI-Betonginstitut	95,2 och 99,6 Mpa	Not evaluated	SS-EN 12390-3 SS 13 72 07	DI:2413538 Bilaga 2	
RAB	R1	Inneslutningen	Tunnslip	Koniska delen	2017	K40 och K50	3	?	CBI-Betonginstitut	Tabell 1 och 2 i bilaga 3	-	Polarisationsmikroskopi	DI:2413538 Bilaga 3	
RAB	R3	Inneslutningen	Tryckhållfasthet	Missilskydd inneslutningsvägg	2019	K500	3	ca 65	CBI-Betonginstitut	68,7; 68,9 och 77,2 Mpa	Not evaluated	SS-EN 12390-3/AC:2011	DI:2471485	
OKG	O1	Reaktorinneslutning, biologiska skärmen	Tryckhållfasthet	Biologiska skärmens övre del	1990	40 Mpa enl ritning	9	cylinder med diam 93 mm	NCC/CBI	Medelvärdet = 82 Mpa		SS-13 72 30	1-637/90	O1 togs i drift 1972
OKG	O1	Reaktorinneslutning, biologiska skärmen	Tunnslip	Biologiska skärmens övre del	1990		5, varav 2 prov togs 10-18 cm in i konstruktionen		NCC/CBI	Inga sprickor eller sekundära reaktioner förekommer			1-637/90	O1 togs i drift 1972
OKG	O1	Reaktorinneslutning, biologiska skärmen	Karbonatisering	Biologiska skärmens övre del	1990		8		NCC/CBI	Max 1 mm karbonariserings-djup		Utfördes med fenolftalinlösning direkr efter urborrning	1-637/90	O1 togs i drift 1972

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OK G	O1	Turbinbyggnad, transformatorbås	Tryckhållfasthet	Fundament till transformator T12	2015	K30	4	67 mm	NCC/CBI	65,7 - 95,4 Mpa (C60/75), Vct-tal uppskattades till 0,35-0,40	Ja	SS-EN 12390-3:2009 (densitet enligt SS-EN 12390-7:2009)	5P00127	O1 togs i drift 1972
OK G	O1	Turbinbyggnad, transformatorbås	Tunnslip	Fundament till transformator T12	2015		2	70-55 mm	NCC/CBI	Vct, 0,35 - 0,40	Ja	NTBUILD 361 för Vct	5P00127	O1 togs i drift 1972
OK G	O1	Turbinbyggnad, transformatorbås	Karbonatisering	Fundament till transformator T12	2015		3		NCC/CBI	1 - 2 mm	Ja	SS 13 72 42, förfarande A	5P00127	O1 togs i drift 1972
OK G	O1	Turbinbyggnad, transformatorbås	Kloridhalt	Fundament till transformator T12	2015		3		NCC/CBI	0,01 - 0, 06 vikt %	Ja	CBI:metoden 5, Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	5P00127	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Tryckhållfasthet	Fundament till huvudkylvatten-pumpar	2014	K300	7	77 mm, längd 60-110 mm	NCC/CBI	C55/60	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00699	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Tunnslip	Fundament till huvudkylvatten-pumpar	2014		1		NCC/CBI	Vct, 0,35	Ja		3P00699	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Karbonatisering	Fundament till huvudkylvatten-pumpar	2014		8		NCC/CBI	0-5 mm	Ja	SS 13 72 42, förfarande A	3P00699	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Kloridhalt	Fundament till huvudkylvatten-pumpar	2014		8		NCC/CBI		Ja	CBI:metoden 5, Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00699	O1 togs i drift 1972

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OK G	O1	Intagsbyggnad (Silstation)	Täckskikt	Fundament till huvudkylvatten-pumpar	2014		12		NCC/CBI	8-40 mm	Ja		3P00699	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Tryckhållfasthet	Silutrymmen	2010	K300	6	95 mm, längd 85-115 mm	NCC/CBI	98,5 - 76,0 Mpa	Ja	SS-EN 12390-3:2001	PX00062	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Tunnslip	Silutrymmen	2010				NCC/CBI		Ja		PX00062	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Karbonatisering	Silutrymmen	2010		8		NCC/CBI	1-9 mm	Ja	SS 13 72 42, förfarande A	PX00062	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Kloridhalt	Silutrymmen	2010		24		NCC/CBI		Ja	CBI:metoden 5, Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	PX00062	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Kloridhalt	Pumpbassäng 1.94	2009	K300	3		NCC/CBI	1,59, 2,59, 1,98 kloridjoner/cement (vikt/%)	Ja		P900338	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Kloridhalt	Pumpbassäng 1.94	2010	K300	18		NCC/CBI	2,1 - 3,0 kloridjoner/cement (vikt/%)	Ja	CBI:metoden 5, Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	PX00403	O1 togs i drift 1972
OK G	O1	Intagsbyggnad (Silstation)	Tryckhållfasthet	Undergjutnings-betong till huvudkylvatten-pumpar	2013		10	46,3 - 46,4	NCC/CBI	98,9 - 70,8 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00149	O1 togs i drift 1972

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OKG	O1	Intagsbyggnad (Silstation)	Kloridhalt	Undergjutnings-betong till huvudkylvatten-pumpar	2013		4		NCC/CBI	0,22 - 2,35 kloridjoner/cement (vikt/%)	Ja	CBI:metoden 5, Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00149	O1 togs i drift 1972
OKG	O2	Reaktorinneslutning	Tryckhållfasthet	HC-vägg	2014		3	73 mm	NCC/CBI	68,1 - 70,1 Mpa	Ja		4P00440	O2 togs i drift 1974
OKG	O2	Reaktorinneslutning	Töjning	HC-vägg	2014		3	73 mm	NCC/CBI	37,3 - 36,3 Gpa	Ja		4P00440	O2 togs i drift 1974
OKG	O2	Reaktorinneslutning	Tunnslip	HC-vägg	2014				NCC/CBI	Vct, 0,45 - 0,5	Ja	NTBUILD 361	4P00440	O2 togs i drift 1974
OKG	O2	Ventilationsskorsten	Tryckhållfasthet	Skorsten (borrkärnors plats ej angivna, troligtvis i foten)	2013	K400	2	46 mm	NCC/Rope Acess/CBI	67, 0/62,3 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00607	O2 togs i drift 1974
OKG	O2	Ventilationsskorsten	Karbonatisering	Skorsten (borrkärnors plats ej angivna, troligtvis i foten)	2013				NCC/Rope Acess/CBI	2-5 mm	Ja	SS 13 72 42, förfarande A	3P00607	O2 togs i drift 1974
OKG	O2	Ventilationsskorsten	Kloridhalt	Skorsten (borrkärnors plats ej angivna, troligtvis i foten)	2013				NCC/Rope Acess/CBI	0,06-0,08 Kloridjoner/cement (vikt-%)	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00607	O2 togs i drift 1974

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OK G	O2	Intagsbyggnad, kylvattenvägar	Tryckhållfasthet	Inloppsstråk-711, 713	2013	K300	17	77 mm, längd 65-115 mm	NCC/CBI	62,2 - 101,6 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00483	O2 togs i drift 1974
OK G	O2	Intagsbyggnad, kylvattenvägar	Tunnslip	Inloppsstråk-711, 713	2013		3		NCC/CBI	Vct 0,35	Ja	NTBUILD 361	3P00483	O2 togs i drift 1974
OK G	O2	Intagsbyggnad, kylvattenvägar	Karbonatisering	Inloppsstråk-711, 713	2013		18		NCC/CBI	0-1 mm	Ja	SS 13 72 42, förfarande A	3P00483	O2 togs i drift 1974
OK G	O2	Intagsbyggnad, kylvattenvägar	Kloridhalt	Inloppsstråk-711, 713	2013		22		NCC/CBI	0,10-1,93 0,06-0,08 Kloridjoner/cement (vikt-%)	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00483	O2 togs i drift 1974
OK G	O2	Kulvert	Tryckhållfasthet	Aktiv kulvert	2013	K300	7	64	NCC/CBI	88,1 - 57,8	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00332	O2 togs i drift 1974
OK G	O2	Kulvert	Tunnslip	Aktiv kulvert	2013	K300	4		NCC/CBI	Vct 0,45	Ja	NTBUILD 361	3P00332	O2 togs i drift 1974
OK G	O2	Kulvert	Karbonatisering	Aktiv kulvert	2013	K300	7		NCC/CBI	0-3 mm	Ja	SS 13 72 42, förfarande A	3P00332	O2 togs i drift 1974

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OK G	O2	Kulvert	Kloridhalt	Aktiv kulvert	2013	K300	14		NCC/CBI	0,03-0,13	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00332	O2 togs i drift 1974
OK G	O2	Reaktorbyggnad	Kloridhalt	Vägg i bergspalt	2009	K300	2		OKG/CBI	0,18, 2,50 Kloridjoner/cement vikt %			P900338	O2 togs i drift 1974
OK G	O2	Reaktorbyggnad	Karbonatisering	Vägg i bergspalt	2009	K300	1		OKG/CBI	7 mm		SS 13 72 42 förfarande A	P900338	O2 togs i drift 1974
OK G	O2	Intagsbyggnad (Rensverksbyggnad)	Tryckhållfasthet	Pumpbassäng F2.16	2014	K300	10	77 mm	NCC/CBI	71,8 - 92,5 MPa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00484	O2 togs i drift 1974
OK G	O2	Intagsbyggnad (Rensverksbyggnad)	Tunnslip	Pumpbassäng F2.16	2014	K300			NCC/CBI	Vct 0,35	Ja	NTBUILD 361	3P00484	O2 togs i drift 1974
OK G	O2	Intagsbyggnad (Rensverksbyggnad)	Karbonatisering	Pumpbassäng F2.16	2014	K300	11		NCC/CBI	0-12 mm	Ja	SS 13 72 42, förfarande A	3P00484	O2 togs i drift 1974
OK G	O2	Intagsbyggnad (Rensverksbyggnad)	Kloridhalt	Pumpbassäng F2.16	2014	K300	16		NCC/CBI	0,08 - 1,12 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00484	O2 togs i drift 1974

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OK G	O2	Intagsbyggnad (Rensverksbyggnad), In- och utloppstunnlar	Kloridhalt	Rensverksbyggad	1997	K300			STK	0,0005 - 0,0080 Kloridhalt som % av betongvikt	Ja		2010-10085	O2 togs i drift 1974
OK G	O2	Intagsbyggnad (Rensverksbyggnad), In- och utloppstunnlar	Kloridhalt	Inloppskulvert, 434	1997	K300			STK	0,05 % Cl rel betongvikt	Ja		2010-10085	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Tryckhållfasthet	Inloppskulvertar 434, högaktiv kulvert	2014	K300	17	77 mm	NCC/CBI	115,1 - 47,3 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00555	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Tunnslip	Inloppskulvertar 434, högaktiv kulvert	2014	K300	3		NCC/CBI	Vct 0,35	Ja	NTBUILD 361	3P00555	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Karbonatisering	Inloppskulvertar 434, högaktiv kulvert	2014	K300	23		NCC/CBI	0 - 3 mm	Ja	SS 13 72 42, förfarande A	3P00555	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Kloridhalt	Inloppskulvertar 434, högaktiv kulvert	2014	K300	29		NCC/CBI	0,04 - 3.47 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00555	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Tryckhållfasthet	Utloppskulvertar 434	2013	K300	12	77 mm	NCC/CBI	160,5 - 59,8 MPa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00482	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Tunnslip	Utloppskulvertar 434	2013	K300			NCC/CBI	Vct 0,35	Ja		3P00482	O2 togs i drift 1974

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OK G	O2	Turbinbyggnad	Karbonatisering	Utloppskulvertar 434	2013	K300	15		NCC/CBI	0-3 mm	Ja	SS 13 72 42, förfarande A	3P00482	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Kloridhalt	Utloppskulvertar 434	2013	K300	23		NCC/CBI	0,01 - 1,41 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P00482	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Tryckhållfasthet	Utlopp, D3.61	2012	K300	5	71 mm	NCC/CBI	80,0 - 73,8 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	PX20364	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Tunnslip	Utlopp, D3.61	2012	K300	13		NCC/CBI	Vct 0,45	Ja		PX20364	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Karbonatisering	Utlopp, D3.61	2012	K300			NCC/CBI	0-2 mm	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	PX20364	O2 togs i drift 1974
OK G	O2	Turbinbyggnad	Kloridhalt	Utlopp, D3.61	2012	K300			NCC/CBI	0,10 - 2,11 Kloridjoner/cement vikt %	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	PX20364	O2 togs i drift 1974
OK G	O3	Turbinbyggnad	Karbonatisering	Rum D02.03	2009	K30	1		OKG/CBI	1 mm	Ja	SS 13 72 42, förfarande A	P900338	O3 togs i drift 1985

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OKG	O3	Turbinbyggnad	Kloridhalt	Rum D02.03	2009	K30	2		OKG/CBI	1, 56, 3,05 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.1995. Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	P900338	O3 togs i drift 1985
OKG	O3	Reaktorbyggnad	Tryckhållfasthet	Plan B01 - B2	2008	K40	30	99 mm	NCC/CBI	28 - 47 Mpa	Ja	SS-EN 12390-3:2001	F80874	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Tryckhållfasthet	Kanal L7, L8, L12	2014	K40	24	96 mm	NCC/CBI	66,2 - 100,9 MPa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	4P00295A	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Tunnslip	Kanal L7, L8, L12	2014	K40	6		NCC/CBI	0,35 - 0,50	Ja	NTBUILD361	4P00295A	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Karbonatisering	Kanal L7, L8, L12	2014	K40	40		NCC/CBI	1 - 32 mm	Ja	SS 13 72 42, förfarande A	4P00295A	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Kloridhalt	Kanal L7, L8, L12	2014	K40	58		NCC/CBI	0,02 - 2,10 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	4P00295A	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Tryckhållfasthet	Stråk 2 och 3, 441-PD1 och 441PA1	2011	K40	18	46/96 mm	NCC/CBI	54,9 - 88,0 MPa	Ja		PX10362	O3 togs i drift 1985

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OK G	O3	Kylvattenvägar	Tunnslip	Stråk 2 och 3, 441-PD1 och 441PA1	2011	K40	3		NCC/CBI		Ja		PX10362	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Karbonatisering	Stråk 2 och 3, 441-PD1 och 441PA1	2011	K40			NCC/CBI	0-10 mm	Ja		PX10362	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Kloridhalt	Stråk 2 och 3, 441-PD1 och 441PA1	2011	K40	20		NCC/CBI	0,15 - 1,21 Kloridjoner/cement vikt %	Ja		PX10362	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Tryckhållfasthet	Kanal L5	2013	K40	7	64 mm	NCC/CBI	39,8 - 78,0 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	3P00333	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Kloridhalt	Kanal L5	2013	K40	21		NCC/CBI	0,06 - 2,94 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	3P0033	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Tryckhållfasthet	Kylvattenutlopp	2016	K40	9	55, 47, 66, 76 mm	NCC/CBI	85,0 - 48,5 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	6P00167-1	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Karbonatisering	Kylvattenutlopp	2016	K40	15		NCC/CBI	1 -22 mm	Ja	SS 13 72 42, förfarande A	6P00167-1	O3 togs i drift 1985
OK G	O3	Kylvattenvägar	Kloridhalt	Kylvattenutlopp	2016	K40	Flertalet		NCC/CBI		Ja	CBI:metoden 5.Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	6P00167-1	O3 togs i drift 1985

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OKG	O3	Kylvattenvägar	Tryckhållfasthet	Kylvatteninlopp	2015	K40	12	45, 77 mm	NCC/CBI	55,0 - 81,3 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	5P00316	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Tunnslip	Kylvatteninlopp	2015	K40	1	0,35	NCC/CBI	Vct 0,35	Ja	NTBUILD361	5P00316	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Karbonatisering	Kylvatteninlopp	2015	K40	16		NCC/CBI	1 - 22 mm	Ja	SS 13 72 42, förfarande A	5P00316	O3 togs i drift 1985
OKG	O3	Kylvattenvägar	Kloridhalt	Kylvatteninlopp	2015	K40	24		NCC/CBI	0,01 - 2,35 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	5P00316	O3 togs i drift 1985
OKG	KYL.112	Kylvattenvägar	Tryckhållfasthet	Utloppstunel L6	2015	K300	9	66, 76 mm	NCC/CBI	69,0 - 112,0 Mpa	Ja	SS-EN 12390-3:2009 (tryckhållfasthet), SS-EN 12390-7:2009 (densitet)	5P00317	KYL.112 togs i drift 1974
OKG	KYL.112	Kylvattenvägar	Tunnslip	Utloppstunel L6	2015	K300	1		NCC/CBI	Vct 0,35	Ja	NTBUILD361	5P00317	KYL.112 togs i drift 1974
OKG	KYL.112	Kylvattenvägar	Karbonatisering	Utloppstunel L6	2015	K300	12		NCC/CBI	1 - 4 mm	Ja	SS 13 72 42, förfarande A	5P00317	KYL.112 togs i drift 1974

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OKG	KYL.112	Kylvattenvägar	Kloridhalt	Utloppstunel L6	2015	K300	24		NCC/CBI	0,01 - 4,02 Kloridjoner/cement vikt %	Ja	CBI:metoden 5.Total klorid i hårdnad betong, direktpotentio-metrisk metod med jonselektiv elektrod	5P00317	KYL.112 togs i drift 1974
OL	OL1	Containment		Prestressed testbeam									O-TV-M-49; 50-0-80-BET; B 13564	
OL	OL2	Containment		Prestressed testbeam	1978								TVO II, Provbalkor; O-TV-M-49; 50-0-80-BET; B 13564	
OL	OL1	Containment	Compressive Strength	Prestressed testbeam	1977				VTT				AA, 1977	
OL	OL1	Containment	Compressive Strength	Prestressed testbeam	1977		8		VTT				B8345	
OL	OL2	Containment	Strain	Prestressed testbeam	1980, 1981								TVO II, Venymämittaukset -80, -81	
OL	OL1	Containment	Deformations under stress; Prestress force; Compressive Strength; Static modulus of elasticity	Prestressed testbeam "A1"	1983		9		VTT				BET06383	
OL	OL1	Containment	Static modulus of elasticity; Compressive Strength; Carbonation;	Prestressed testbeam "B1"	1983		9		VTT				BET35243	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OL														
OL														
OL	OL2	Containment	NDT; Ultrasonic Pulse Echo	Pipe Entries	2001				FORCE Institute				B1-10268 PSH/cbs	
OL	OL1	Containment	Betratron		2004		7		VTT				TUO77-044322	
OL	OL1/2	Containment	NDE; MASW; Radar;Impact-Echo;Cover-Meter;UPE		2005				FORCE Institute				B5-17276/JRC/akk	
OL	OL1	Cooling Water Channel	Chloride, Thin section	Outlet, S3	1994		6	35	VTT				RTE50379/94	
OL	OL2	Cooling Water Channel	Chloride, Thin section	Outlet, S2, S4	1994		6	35	VTT				RTE50380/94	
OL	OL2	Cooling water building	Chloride	pump pit 712	2000		5	50	Fortum		0-20,20-40,40-60		TECH-2750	
OL	OL1/2	Cooling Water Channel	Electro-chemical-potential; Ultrasonic Pulse Echo	Zinc Cover	2001				FORCE Institute				FORCE, 2001	
OL	OL1/2	Cooling water building	Thin Section	127; 712	2001		10		Aaro Kohonen oy				121101	
OL	OL1/2	Cooling water building	Chloride	127; 712	2001				Tutkimus-KORTES oy		0-20,20-40,40-60	SFS 5451	O1363/02	
OL	OL1/2	Cooling Water Channel	Cover-Meter;Electro-chemical-potential; Corrosion rate;	Channels and cathodic protection	2002				FORCE Institute				B2-11772 PSH/cbs	
OL	OL1/2	711	chloride	L2, L4	2002		10		Tutkimus-KORTES		0-20,20-40,40-60		O1451/02	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OL	OL1/2	711	Tensile Strength	L3 / C7, L1 / C5	2003		14		FCM				040603	
OL	OL1	Cooling Water Channel	Chloride; Cover-Meter;Carbonation; Electro-chemical-potential	Incl. T93.14, T91.17 and 711.L4	2003				FORCE Institute				B3-2954/PSH/akk	
OL	OL1	Cooling Water Channel	Betratron	Inlet channel, rock anchors	2004		5		VTT				TUO77-044322	
OL	OL1	Cooling water building	Compressive Strength	T91.14, R04	2004		3		Contesta		shotcrete		A-3620	
OL	OL1	Cooling water building	Chloride	T91.14, R04	2004		3		Tutkimus-KORTES oy		shotcrete		O3275/04	
OL	OL1	Cooling water building	Tensile Strength	T91.14, R04	2004		3		FCM		shotcrete		041304	
OL	OL2	T; Cooling water building	Chloride profile; Tensile strength; Thin Section; Carbonation	2.711L4, 2.T93.05	2006				Aaro Kohonen oy				Olkidoc 153891; 1590180	
OL	OL2	Cooling water building	Compressive Strength; Thin Section; Chloride	S1-apumerivesikanavan pumppukuoppa	2015	K40		65	Sweco				R5_159 0500	
OL	OL1	Turbinebuilding	Thin Section; Chloride	D91.42	2002				Contesta				X-9352	
OL	OL1	incl. Turbinebuilding	Chloride	D91.42; T93.14; 711 L1; 112 S3	2002		42		Tutkimus-KORTES		0-20,20-40,40-60		O1658/02	
OL	OL2	incl. Turbinebuilding	Chloride	D91.42; T93.14; 711 L3	2002		11		Tutkimus-KORTES		0-20,20-40,40-60		O1584/02	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OL	OL1	incl. Turbinebuilding	Chloride	D91.42; 112 S2; D92.12; 112 S2; T93.14;	2004		17		Tutkimus-KORTES				O3445/04	
OL	OL1	Turbinebuilding	Compressive Sterngth	D91.20, D91.21	2007		3	100	Contesta				B-1015	
OL	OL1	Turbinebuilding	Static modulus of elasticity; Compressive strength	Turbiinipeti, turbinebed	2008	K25, K30	9	100	Aaro Kohonen oy				1590270-01	
OL	OL2	Turbinebuilding	Thin Section	D91.42	2012		4		FCM				070212	
OL	OL2	Turbinebuilding	Thin Section	D91.42	2012		3		FCM				080111	
OL	OL1/2	Turbinebuilding	Thin Section; Compressive Strength; Tensile Strength; Chloride; Sulfite	Souht-west outer wall	2019	K25, K30		50	Vahanen Rakennus-fysiikka Oy				Olkidoc 183066; RAFY 2936 TVO OL1 ja OL2 seinät	
OL	OL2	Turbinebuilding	Thin Section, Chloride, Tensile Strength	Outlet tunnel	2019			50	Vahanen				RAFY 2042-4	
OL	OL1/2	Transformer protection walls	Carbanation; Thin Section; Tensile Strength; Chloride		2012			50	Aaro Kohonen oy				1590420	
OL	OL2	Controlbuilding	Thin Section; Compressive Strength; Tensile Strength; Chloride; Sulfite	east outer wall	2019	K30		50	Vahanen				Olkidoc 183066; RAFY 2936	
OL	OL1/2	Tunnels	Thin Section; Compressive Strength; Tensile Strength; Chloride; Sulfite	North-east, Outer wall	2019	K30		50	Vahanen Rakennus-fysiikka Oy				Olkidoc 183066; RAFY 2936	

NPP	Unit	Building	Type of test	Location of test	Year	Original Strength class	Number of samples	Diameter of sample mm	Performer	Value	Evalu-ation of samples	Test method/ Code	Documen tation	Note
OL	OL0	Käyttövedenpuhdistamo, Potaple water purification	Carbonation; Thin Section; Tensile Strength	731 water tank	2005	K30, VT		50	Aaro Kohonen oy				Olkidoc 153867; 1590140	
OL	OL0	Käyttövedenpuhdistamo, Potaple water purification	Carbonation; Thin Section; Chloride; Tensile Strength	0.731T6 (T3, T4, T5)	2006			50	Aaro Kohonen oy				Olkidoc 153906; 1590190	
OL	OL0	Sulapumppaamo	Thin Section; Compressive Strength	Kansilaatta;T1, T2; T3	2008				FCM				082808M1	
OL	OL0	Olkiluoto bridge	Thin Section		2008		3		FCM				072508	
OL														
OL	OL0	Light mast	Thin Section	foundation	2009		2		FCM				052209	
OL	OL0	Light mast	Thin Section	foundation	2008		2		FCM				112108	
OL	OL0	Light mast	Thin Section	foundation	2009		3		FCM				082509	
OL	Y	KPA	Visual Inspection		2008				Aaro Kohonen oy				1590310	
OL	Y	KPA	Carbonation; Chloride; Sulfite; Compressive Strength; Tensile Strength; Thin Section;		2009				Aaro Kohonen oy				1590330	
OL	Y	KPA	Carbonatio; Thin Section		2009				Aaro Kohonen oy				1590330-1	
OL	L	VLJ	Thin Section	Drive way	2002		4		FMC				20202	
OL	L	VLJ	Sulfite, chloride	Drive way	2002 , 2001		4		Tutkimus-KORTES				O1365/02, O1364/02	
OL			Chloride		2010		1		VTT				VTT-S-03773-10	

COMPILATION OF CONCRETE TEST DATA FROM THE NUCLEAR INDUSTRY

In this project an effort has been made to collect and compile results from various concrete testing performed at the nuclear power plants Ringhals, Oskarshamn and Forsmark in Sweden and Olkiluoto in Finland. In total results from 215 tests have been compiled performed during different time periods from the construction phase until recently. Approximately half of the compiled data regards tests for determining the compressive strength of the concrete and analyzing the chlorides contents in the concrete. Other types of tests are e.g. determination of carbonation depths, water penetration depth and analysis of thin sections.

The majority of the test data has not been evaluated in the original reports, therefore only results directly from the tests have been compiled. As a consequence the data cannot be used directly in theoretical analyses. Example of an evaluation method is the standardized procedure for determining the characteristic strength and concrete strength class.

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