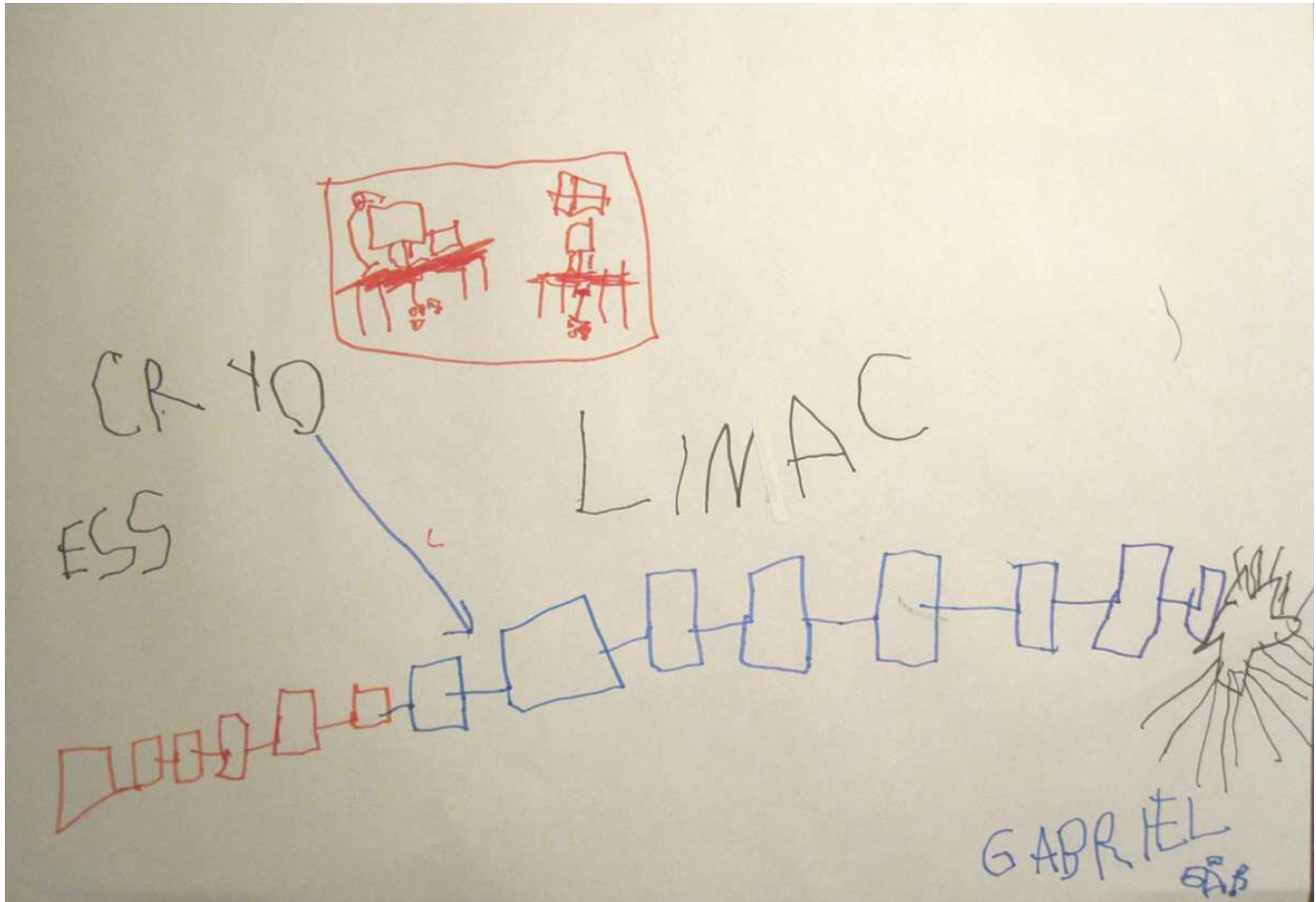




# ESS Conceptual Design Report



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PRELIMINARY DRAFT: NOT READY FOR CIRCULATION

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# Contents

<b>1</b>	<b>Introduction (Carlile)</b>	<b>4</b>
1.1	Primary parameters . . . . .	4
1.2	Scientific need and discovery potential . . . . .	4
1.3	Schedule . . . . .	4
1.4	Site . . . . .	4
<b>2</b>	<b>Neutron Science (Argyriou)</b>	<b>5</b>
2.1	Introduction . . . . .	5
2.2	Instrument Support . . . . .	5
2.2.1	Detectors . . . . .	5
2.2.2	Choppers . . . . .	5
2.2.3	Sample environment . . . . .	5
2.2.4	Neutron optics . . . . .	5
2.2.5	Polarization . . . . .	5
2.3	Science support labs . . . . .	5
2.3.1	Deuteration . . . . .	5
2.3.2	Actinide . . . . .	5
2.3.3	Bio-hazard . . . . .	5
2.3.4	[Others] . . . . .	5
2.4	Instruments . . . . .	5
2.4.1	Day-one instruments . . . . .	5
2.4.2	Full instrument suite . . . . .	5
2.4.3	Sample preparation labs . . . . .	5
2.4.4	Source neutronics and beam extraction . . . . .	5
2.4.5	Guides and shielding . . . . .	5
2.5	Potential upgradeability . . . . .	5
<b>3</b>	<b>Target (Mezei)</b>	<b>6</b>
3.1	Design choices . . . . .	6
3.2	Neutronic performances . . . . .	6
3.3	Operational description . . . . .	6
3.3.1	Nominal power operation . . . . .	6
3.3.2	Confinement barriers description . . . . .	6
3.3.3	Operational margins . . . . .	6
3.3.4	Mechanical design principles . . . . .	6
3.4	Monolith . . . . .	6
3.4.1	General layout . . . . .	6
3.4.2	Target systems . . . . .	6
3.4.3	Pre-moderators, moderators and reflectors . . . . .	6
3.4.4	Proton beam window systems . . . . .	6
3.4.5	Neutron beam extraction . . . . .	6
3.4.6	Internal shielding . . . . .	6
3.4.7	Monolith Helium cooling system . . . . .	6
3.5	Hot cells and radioactive handling system . . . . .	6
3.5.1	Hot cell . . . . .	6
3.5.2	Decontamination cell . . . . .	6
3.5.3	Transfer casks . . . . .	6
3.6	Ancillaries . . . . .	6
3.6.1	HVAC . . . . .	6
3.6.2	Secondary cooling systems . . . . .	6
3.6.3	Gas supply and storage . . . . .	6
3.6.4	Liquid supplies and storage . . . . .	6

3.6.5	Fire protection system . . . . .	6
3.6.6	Additional shielding outside monolith . . . . .	6
3.7	Additional shielding outside monolith . . . . .	6
3.8	Waste management . . . . .	6
3.8.1	Estimating irradiated component activation . . . . .	6
3.8.2	Solid and liquid waste . . . . .	6
3.9	Accelerator-to-target interface . . . . .	7
3.9.1	Proton beam dumps . . . . .	7
3.9.2	Neutron beam catchers . . . . .	7
3.9.3	Proton beam monitoring system . . . . .	7
3.10	Control principles . . . . .	7
3.11	Irradiated components lifetime and materials . . . . .	7
3.12	Prototype optimization and development . . . . .	7
3.13	Potential upgradeability . . . . .	7
<b>4</b>	<b>Accelerator (Lindroos)</b>	<b>8</b>
4.1	Accelerator parameters and design choices . . . . .	8
4.2	Beam Physics . . . . .	8
4.2.1	Beam-line lattice and dynamics . . . . .	8
4.2.2	Tolerances and correction systems . . . . .	8
4.2.3	Beam power limitations . . . . .	8
4.2.4	Operational considerations and reliability . . . . .	8
4.2.5	Beam losses and collimation . . . . .	8
4.3	Normal conducting linac . . . . .	8
4.4	Spoke superconducting linac . . . . .	8
4.5	Elliptical superconducting linac . . . . .	8
4.6	High Energy Beam Transport . . . . .	8
4.7	RF systems . . . . .	8
4.7.1	Power generation . . . . .	8
4.7.2	Power distribution . . . . .	8
4.7.3	Low-level RF . . . . .	8
4.7.4	Normal-conducting linac . . . . .	8
4.7.5	Superconducting linac . . . . .	8
4.7.6	Higher Order Modes . . . . .	8
4.8	Cryogenic systems . . . . .	8
4.8.1	Cryomodules . . . . .	8
4.9	Vacuum systems . . . . .	8
4.10	Beam instrumentation . . . . .	8
4.11	Magnet systems . . . . .	8
4.11.1	[quads, dipole corrs, HTS bends ...] . . . . .	8
4.12	Potential upgrades . . . . .	8
<b>5</b>	<b>Control Systems (Trahern)</b>	<b>9</b>
5.1	Architecture . . . . .	9
5.2	Control Box . . . . .	9
5.2.1	Hardware . . . . .	9
5.2.2	Software . . . . .	9
5.3	Signal list . . . . .	9
5.4	Timing . . . . .	9
5.5	Machine Protection System . . . . .	9
5.6	Data networks . . . . .	9
5.7	Target control . . . . .	9
5.8	Instrument control . . . . .	9

<b>6</b>	<b>Data Management (Skelboe)</b>	<b>10</b>
6.1	Data acquisition . . . . .	10
6.2	Data storage . . . . .	10
6.3	Data analysis, modeling and visualization . . . . .	10
<b>7</b>	<b>Conventional Facilities and Site (Hedin)</b>	<b>11</b>
7.1	Accelerator tunnel and klystron gallery . . . . .	11
7.2	Target buildings and facilities . . . . .	11
7.3	Experimental halls and facilities . . . . .	11
7.4	Shielding . . . . .	11
<b>8</b>	<b>Safety, Health, and Environment (Jacobsson)</b>	<b>12</b>
8.1	General Safety Objectives . . . . .	12
8.2	Radiation Protection . . . . .	12
8.2.1	Safety Systems . . . . .	12
8.3	Non-radioactive Hazards . . . . .	12
8.4	Personnel Protection System . . . . .	12
<b>9</b>	<b>Integration (Rådahl)</b>	<b>13</b>
9.1	Survey and alignment . . . . .	13
9.2	Cable trays . . . . .	13
<b>10</b>	<b>Utilities and Energy Management (Parker)</b>	<b>14</b>
10.1	Renewable energy . . . . .	14
10.2	Building HVAC . . . . .	14
10.3	Cooling systems and water . . . . .	14
10.4	Electrical power systems . . . . .	14
10.5	Other utilities . . . . .	14
<b>11</b>	<b>Conclusions (Carlile)</b>	<b>15</b>
11.1	Cost summary . . . . .	15
<b>12</b>	<b>Appendix A: "Prepare-to-Build" prototyping (Brisfors)</b>	<b>16</b>
<b>13</b>	<b>Appendix B: Construction and Installation (Brisfors)</b>	<b>17</b>
<b>14</b>	<b>Appendix C: Commissioning and Operations (Carlsson)</b>	<b>18</b>
<b>15</b>	<b>Appendix D: Licensing Process (Jacobsson)</b>	<b>19</b>
<b>16</b>	<b>Appendix E: Backup target system concept (Noah)</b>	<b>20</b>

# 1 Introduction (Carlile)

## 1.1 Primary parameters

The European Spallation Source is a state-of-the-art .....

Beam Power	[MW]	5.0
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Table 1: Primary parameters of the European Spallation Source.

More words here.

## 1.2 Scientific need and discovery potential

## 1.3 Schedule

## 1.4 Site

## **2 Neutron Science (Argyriou)**

### **2.1 Introduction**

### **2.2 Instrument Support**

#### **2.2.1 Detectors**

#### **2.2.2 Choppers**

#### **2.2.3 Sample environment**

#### **2.2.4 Neutron optics**

#### **2.2.5 Polarization**

### **2.3 Science support labs**

#### **2.3.1 Deuteration**

#### **2.3.2 Actinide**

#### **2.3.3 Bio-hazard**

#### **2.3.4 [Others]**

### **2.4 Instruments**

#### **2.4.1 Day-one instruments**

#### **2.4.2 Full instrument suite**

#### **2.4.3 Sample preparation labs**

#### **2.4.4 Source neutronics and beam extraction**

#### **2.4.5 Guides and shielding**

### **2.5 Potential upgradeability**

- 3 Target (Mezei)**
  - 3.1 Design choices**
  - 3.2 Neutronic performances**
  - 3.3 Operational description**
    - 3.3.1 Nominal power operation**
    - 3.3.2 Confinement barriers description**
    - 3.3.3 Operational margins**
    - 3.3.4 Mechanical design principles**
  - 3.4 Monolith**
    - 3.4.1 General layout**
    - 3.4.2 Target systems**
    - 3.4.3 Pre-moderators, moderators and reflectors**
    - 3.4.4 Proton beam window systems**
    - 3.4.5 Neutron beam extraction**
    - 3.4.6 Internal shielding**
    - 3.4.7 Monolith Helium cooling system**
  - 3.5 Hot cells and radioactive handling system**
    - 3.5.1 Hot cell**
    - 3.5.2 Decontamination cell**
    - 3.5.3 Transfer casks**
  - 3.6 Ancillaries**
    - 3.6.1 HVAC**
    - 3.6.2 Secondary cooling systems**
    - 3.6.3 Gas supply and storage**
    - 3.6.4 Liquid supplies and storage**
    - 3.6.5 Fire protection system**
    - 3.6.6 Additional shielding outside monolith**
  - 3.7 Additional shielding outside monolith**
  - 3.8 Waste management**
    - 3.8.1 Estimating irradiated component activation**
    - 3.8.2 Solid and liquid waste**



- 3.9 Accelerator-to-target interface**
  - 3.9.1 Proton beam dumps**
  - 3.9.2 Neutron beam catchers**
  - 3.9.3 Proton beam monitoring system**
- 3.10 Control principles**
- 3.11 Irradiated components lifetime and materials**
- 3.12 Prototype optimization and development**
- 3.13 Potential upgradeability**

## 4 Accelerator (Lindroos)

### 4.1 Accelerator parameters and design choices

### 4.2 Beam Physics

#### 4.2.1 Beam-line lattice and dynamics

#### 4.2.2 Tolerances and correction systems

#### 4.2.3 Beam power limitations

#### 4.2.4 Operational considerations and reliability

#### 4.2.5 Beam losses and collimation

### 4.3 Normal conducting linac

### 4.4 Spoke superconducting linac

### 4.5 Elliptical superconducting linac

### 4.6 High Energy Beam Transport

### 4.7 RF systems

#### 4.7.1 Power generation

#### 4.7.2 Power distribution

#### 4.7.3 Low-level RF

#### 4.7.4 Normal-conducting linac

#### 4.7.5 Superconducting linac

#### 4.7.6 Higher Order Modes

### 4.8 Cryogenic systems

#### 4.8.1 Cryomodules

### 4.9 Vacuum systems

### 4.10 Beam instrumentation

### 4.11 Magnet systems

#### 4.11.1 [quads, dipole corrs, HTS bends ...]

### 4.12 Potential upgrades

## 5 Control Systems (Trahern)

### 5.1 Architecture

### 5.2 Control Box

#### 5.2.1 Hardware

#### 5.2.2 Software

### 5.3 Signal list

### 5.4 Timing

### 5.5 Machine Protection System

### 5.6 Data networks

### 5.7 Target control

### 5.8 Instrument control

## **6 Data Management (Skelboe)**

**6.1 Data acquisition**

**6.2 Data storage**

**6.3 Data analysis, modeling and visualization**

## **7 Conventional Facilities and Site (Hedin)**

**7.1 Accelerator tunnel and klystron gallery**

**7.2 Target buildings and facilities**

**7.3 Experimental halls and facilities**

**7.4 Shielding**

## **8 Safety, Health, and Environment (Jacobsson)**

### **8.1 General Safety Objectives**

### **8.2 Radiation Protection**

#### **8.2.1 Safety Systems**

### **8.3 Non-radioactive Hazards**

### **8.4 Personnel Protection System**

## 9 Integration (Rådahl)

### 9.1 Survey and alignment

### 9.2 Cable trays

## **10 Utilities and Energy Management (Parker)**

**10.1 Renewable energy**

**10.2 Building HVAC**

**10.3 Cooling systems and water**

**10.4 Electrical power systems**

**10.5 Other utilities**



## 11 Conclusions (Carlile)

### 11.1 Cost summary

## 12 Appendix A: "Prepare-to-Build" prototyping (Brisfors)

## 13 Appendix B: Construction and Installation (Brisfors)

14 Appendix C: Commissioning and Operations (Carlsson)

## 15 Appendix D: Licensing Process (Jacobsson)

## 16 Appendix E: Backup target system concept (Noah)