

Mechanical damage - fly wheel protection

SC A1

Generation mix of the future:

What are the advantages/challenges of such diverse schemes, in terms of both performance and installation/operation costs, to accomplish these goals? Q 1.4

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Project-Specific Content - Project introduction

Some words about risks and safety

1

Risks:

- Huge amount of energy is stored in the FW
- Potential catastrophic failures needs to be considered
- Risk assessment is performed acc to Machinery Directive
- Two main risks are identified in risk assessment (reviewed by WSP):

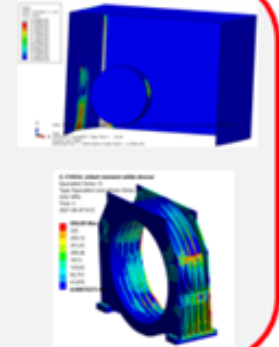
1. Loose rotor event ¹
2. Burst of FW ²



3

Load cases:

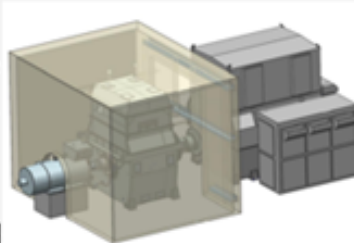
- Case 1: Heavy bump case (regardless enclosure or cage)
- Case 2: Disc failure and create a missile
- For a cage design the same magnitude of load is valid for case 1 & 2
- Capability to care for case 1 & 2 is theoretical verified in a cage design, no test conducted



2

Risk control, acc to project "Bear"

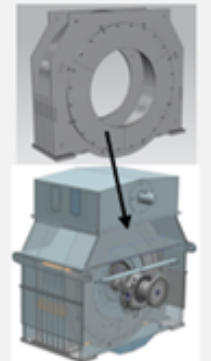
- The original idea "Bear" was to contain the risks in an external safety enclosure
- According to contract, safety enclosure is not scope of ABB -> However, this setup was found to be complicated
- It was decided to develop an integrated protection -> "FW2.0 project"



4

Risk control, acc to PD project "FW2.0"

- High quality forged steel, extensive testing
- Divide Shaft and FW (less fatigue ampl.)
- 2x "tandem" FW discs (less consequence)
- Utilize an **integrated protection cage**
- Advanced calculations performed: FW burst case, cage strength, anchoring stress, foundation stress, etc. (ABB and external)



Mechanical damage fly wheel protection

- Synchronous condenser data: 70 MVA base
 - $H = 1.4 \text{ s}$ & Inertia 8050 kgm^2 (only SC)
 - 4-pol machine
 - 99 MWs stored energy
- SynCon + Flywheel
 - $H > 6 \text{ s}$ & 470 MWs stored energy, Inertia $8050 + 30000 \text{ kgm}^2$
 - Losses 130% compared with 70 MVA SynCon

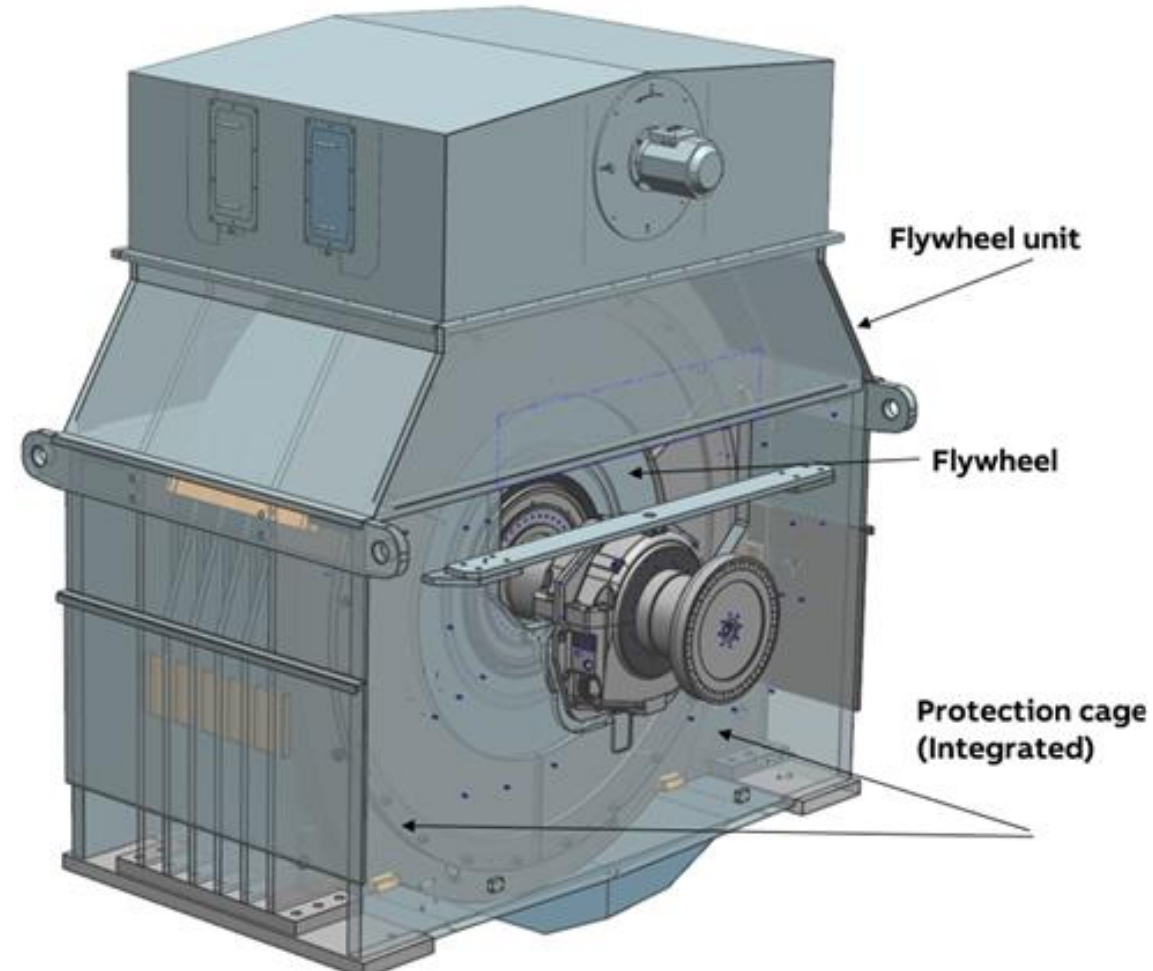


Figure 1: Flywheel for synchronous condenser with integrated protection cage