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Report on the required input data from SP SI and on output safety information for RAPHAEL SP

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RE	Restricted to the partners of the RAPHAEL project	X
CO	Confidential, only for specific distribution list defined on this document	

RAPHAEL (ReActor for Process heat, Hydrogen And ELectricity generation)



ReActor for Process heat, Hydrogen And ELectricty generation (RAPHAEL)		
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Document title						
Report on the required input data from SP SI and on output safety information for RAPHAEL SP						
Abstract						
This document provides the information exchanged between RAPHAEL ST WP4 and other ST WP or other RAPHAEL SP during the two first years of the contract. This mainly concerns: ♦ Request for input data from SP SI (e.g. data of RAPHAEL reference) necessary to perform ST WP4 activities ♦ Provision or validation of safety information necessary to perform RAPHAEL activities First draft of this document corresponds to the period M0 / M24.						
Revisions						
Rev.	Date	Short description	Author	WP Leader	SP Leader	Coordinator
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1 Introduction

This document provides the information exchanged between RAPHAEL ST WP4 and other ST WP or other RAPHAEL SP during the two first years of the contract.

This mainly concerns:

- ◆ Request for input data from SP SI necessary to perform ST WP4 activities,
- ◆ Provision or validation of safety information necessary to perform RAPHAEL activities.

For the considered period, two sets of information have been exchanged:

- ◆ Set 1: Data requested by ST WP1 for D ST1-1 concerning the list of situations likely to be simulated in consistency with safety analysis
- ◆ Set 2: Data requested from SP SI to perform task ST4.2 concerning the application to VHTR, indirect cycle and process heat production to RAPHAEL reference (i.e. ANTARES) : see section 2

2 Information Set 1

2.1 Exchange framework

The information has been requested by ST WP1 for D ST1-1. It concerns the list of situations likely to be simulated in consistency with safety analysis.

The information has been sent by ANPF by M12 (April 2006).

2.2 Information exchanged

Normal conditions

- ◆ Start up
- ◆ Shutdown
- ◆ Load following

List of initiating events

The consequences of initiating events are mitigated if needed by the operational/safety systems, performing the reactivity control, decay heat removal and confinement functions.

- ◆ Reactor trip
- ◆ Control rod drop
- ◆ Inadvertent control rod withdrawal
- ◆ Control rod ejection
- ◆ Malfunction of the IHX cooling systems leading to overcooling (indirect cycle):
 - Increase of secondary gas circulation
 - Increase of steam generator cooling

- ◆ Malfunction of the primary coolers cooling circuits leading to overcooling (direct cycle):
 - Increase of water circulation
 - Increase of water cooling
- ◆ Malfunction of the primary blower leading to overcooling (indirect cycle)
- ◆ Malfunction of the turbomachine leading to overcooling (direct cycle)
- ◆ Inadvertent closure of bypass line (direct cycle)
- ◆ Inadvertent operation of the Shutdown Cooling System at power
- ◆ Partial or complete loss of heat sink (indirect cycle):
 - Failure of secondary gas circulation: gas turbine failure or IHX isolation valve spurious actuation
 - Failure of steam generator cooling: failure of water circulator, failure of condenser cooling, steam/water leakage, increase of heat sink temperature
- ◆ Partial or complete loss of heat sink (direct cycle):
 - Failure of water circulation: pump failure or heat exchanger isolation valve spurious actuation
 - Failure of water cooling: failure of water circulator, water leakage, increase of heat sink temperature
- ◆ Steam Generator leak leading to steam inlet to the secondary gas system (indirect cycle)
- ◆ Leak on the secondary gas circuit (indirect cycle)
- ◆ Inadvertent secondary gas safety valve opening
- ◆ Primary blower malfunction leading to decrease of flowrate (indirect cycle)
- ◆ Turbo machine malfunction leading to decrease of flowrate (direct cycle)
- ◆ Inadvertent opening of by-pass line (direct cycle)
- ◆ Malfunction of Shutdown Cooling System when operating
- ◆ Malfunction of Secondary Heat Removal System when operating (indirect cycle)
- ◆ Loss Of Off-site Power (short/long duration)
- ◆ Primary helium system (primary pressure control) malfunction
- ◆ Secondary gas system (primary pressure control) malfunction (indirect cycle)
- ◆ Flow blockage in Intermediate Heat eXchanger
- ◆ Primary helium leakage/pipe break (pipes connected to the vessels, excluding cross vessel)
- ◆ Primary helium leak within the Pressure Boundary (e.g., through the hot duct)
- ◆ Inadvertent Pressure Boundary safety valve opening
- ◆ Primary helium leakage through the Intermediate Heat eXchanger (indirect cycle)
- ◆ Auxiliary (e.g., SCS, primary blower) heat exchanger leak
- ◆ Primary heat exchanger leak (direct cycle)

3 Information Set 2

3.1 Exchange framework

The information has been requested by ST WP4 (NNC) to SP SI in M19 (November 2006). It concerns the list of data (RAPHAEL reference: ANTARES) necessary to perform D-ST4.3 (Application to RAPHAEL reference: Determination of situations to be considered in the safety demonstration) and D-ST4.4 (Application to RAPHAEL reference: Determination of safety functions and safety equipment).

3.2 Information exchanged

On behalf of Raphael Sub-Project Safety - Work Package 4 Task 2 (WP-ST4), the following formal request for information regarding ANTARES is made by email.

Task ST4.2 covers identification of the list of initiating events and safety functions. The initiating events will be driven by identification of challenges to the main safety functions (control of reactivity, heat removal from the core and confinement of radioactivity). Therefore, details of the systems and mechanisms in the design which directly and indirectly aim to fulfil these safety functions are of primary interest.

The information for ANTARES that is required at this time is a description of the main systems, safety systems and operational conditions. In particular:

- Basic plant design
 - core,
 - primary,
 - secondary,
 - containment
- Summary of operational conditions - at power and shutdown
- For cooling, shutdown and containment in particular, information is required on:
 - Provision and types of main/backup/secondary systems in the design
 - Details of each of these different systems
 - Redundancy within each system (e.g. 3x100% pumps)
 - Basic operation of each type of system (e.g. passive/active, reliance on support systems)
- Summary of refuelling operation and systems
- Summary of types and operation of any support systems required to maintain operation of the main safety systems (e.g. power supplies, gas supplies, ultimate heat sink)