PIP2IT SRF HPRF Distribution Final Design Review Charge

Document number: ED0010286

Name: Victor Grzelak	Date: 5/22/2019	
Org: AD/ENG/RF		
Contact: x6442		
Role: Review Committee Coordinator		
Name: Dave Peterson		
Org: AD/ENG/RF		
Contact: x3073		
Role: Primary Engineer		
Name: Jim Steimel		
Org: PIPII/PIPII/TIO		
Contact: x4826		
Role: L3 Manager		

Revision History

Revision	Date	Originator:	Description of Change
	Release	Role:	
Α	5/23/2019	Coordinator	

Revision control is managed via Fermilab Teamcenter Workflows.

Table of Contents

1.	Introduction	. 3
2.	Review Agenda	. 3
3.	Review Charge Statement	. 4
4.	Acronyms	. 4
5.	Reference Documents	. 6

1. Introduction

The PIP2IT HPRF distribution system in review today will be used for the transfer of RF power to the SRF cavities known as HWR, SSR1, and SSR2. The system must be capable of delivering power to the cavities safely and efficiently and must protect the amplifiers from reverse power. The content of review today begins at the output flange of the high power amplifier, and ends at entrance of the input coupler to the cryomodule.

For the HWR cryomodule there are 8 transmission lines with independent amplifiers and cryomodule couplers for each line. For the SSR1 cryomodule there are an additional 8 transmission lines, amplifiers and crymodule couplers. Each line is equipped with its own circulator and directional coupler. The SSR1 cavity location will also be the testing location for the SSR2 cryomodule. The SSR1 distribution design should be capable of handling SSR2 power levels which are higher than SSR1.

Upon completion of this review, the engineering team can procure and install the rest of the equipment.

2. Review Agenda

SRF HPRF Distribution Review Agenda

Location: Huddle

Date: 5/30/2019

Time: 8AM

Indico Site: https://indico.fnal.gov/event/20563/

Participants:

Victor Grzelak	AD/ENG/RF	Role: Coordinator
John Reid	AD/ENG/RF	Role: Chair
Doug Horan	Argonne	Role: Reviewer
Brian Chase	AD/ENG/RF	Role: Reviewer
Dave Peterson	AD/ENG/RF	Role: Presenter
Jim Steimel	PIPII/PIPII/TIO	Role: Presenter

Agenda details:

- Introduction: Victor Grzelak
 - 1) Charge presentation and goals for review
- II. Overview & Functions: Dave Peterson
 - 1) Functional requirements & physical layout
- III. Calculations & Technical Specifications: Jim Steimel
 - 1) Technical requirements & other considerations
- IV. Interfaces: Dave Peterson
 - 1) How the design satisfies the need
- V. Cost Schedule: Jim Steimel
 - 1) Resource loaded schedule & Distribution BOE,
- VI. Closeout John Reid
 - 1) Discussion and closing remarks

3. Review Charge Statement

The primary charge of this committee is to technically evaluate the efficacy of the RF power distribution system design for the HWR and SSR1/SSR2. The secondary charge is to determine if the system would sufficiently protect itself.

The committee is asked to respond to the following questions:

- 1. Are there any unresolved issues that may have significant safety, cost, schedule or performance impacts?
- 2. Are the risks properly assessed and is the mitigation plan adequate?
- 3. Does the RF distribution design support the project requirements?
- 4. Are the interfaces properly addressed in the design?
- 5. Are the available technical drawings and documentation complete and available?
- 6. Have lessons learned been implemented?
- 7. Is the PIP2IT SRF HPRF distribution final design complete enough to procure the rest of the equipment and complete installation?

4. Acronyms

List and define any relevant acronyms as necessary.

PIP2IT	Proton Improvement Plan 2 Injector Test
HPRF	High Power Radio Frequency
PDR	Preliminary Design Review

5. Reference Documents

The below documents are to be considered in the review, the documents denoted with parenthesis are courtesy documents and are not under review.

Requirements HPRF Distribution Functional Requirements Specification HWR HPRF Distribution Technical Requirement Specification SSR1 HPRF Distribution Technical Requirement Specification SSR1 HPRF Distribution Technical Requirement Specification HWR RF 7kW Circulator Specifications SSR1 RF 7kW Circulator Specifications (162.5 MHz 3kW RF Power Amplifier Technical Specifications) (162.5 MHz 7kW RF Power Amplifier Technical Specifications) Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0004129 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006236 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010276 SSR1 Distribution Risk Assessment ED0010151 19 Failure Mode Effect Analysis Design Circuit Schematic of HWR Design Overall Design Additional Model 3 Overall Design F1010984 4 3D Model and Release Drawings of HWR RF input coupler interface F10054498 3D Model of RF Distribution Test Document Procurement, Production & Installation F10010285						
HWR HPRF Distribution Technical Requirement Specification ED0010279		Requirements				
SSR1 HPRF Distribution Technical Requirement Specification HWR RF 7kW Circulator Specifications SSR1 RF 7kW Circulator Specifications ED0010275 (162.5 MHz 3kW RF Power Amplifier Technical Specifications) ED0010271 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0010271 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0000278 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0000279 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0000279 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0000279 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0000279 Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 ED00004129 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0010281 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety ED0010148 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment ED0010159 Failure Mode Effect Analysis Design Ocircuit Schematic of HWR Design Design Ocircuit Schematic of SSR1 ED0010283 Circuit Schematic of SSR1 ED0010283 Overall Design F10109884 Additional Model 3 Overall Design F10109885 Overall Design F10109885 Additional Model 3 D Model and Release Drawings of HWR RF input coupler interface F10054498 5 3D Model and Release Drawings of SSR1 RF input coupler interface F1005498 F10109855		·	ED0010272			
HWR RF 7kW Circulator Specifications SSR1 RF 7kW Circulator Specifications (162.5 MHz 3kW RF Power Amplifier Technical Specifications) (162.5 MHz 7kW RF Power Amplifier Specifications) (166.5 MHz 7kW RF Power Amplifier Specifications) (167.5 MHz 7kW RF Power Amplifier Specifications) (167.5 MHz 7kW RF Power Amplifier Specifications) (168.6 MHz 7kW RF Power Amplifier Specifications) (16900000000000000000000000000000000		·	ED0010279			
SSR1 RF 7kW Circulator Specifications (162.5 MHz 3kW RF Power Amplifier Technical Specifications) (162.5 MHz 7kW RF Power Amplifier Functional Specifications) (162.5 MHz 7kW RF Power Amplifier Functional Specifications) (162.5 MHz 7kW RF Power Amplifier Technical Specifications) (325 MHz 7kW RF Power Amplifier Technical Specifications) (325 MHz 7kW RF Power Amplifier Technical Specifications) (325 MHz 7kW RF Power Amplifier Technical Specifications) (326 MHz 7kW RF Power Amplifier Technical Specifications) (327 MHz 7kW RF Power Amplifier Technical Specifications) (328 MHz 7kW RF Power Amplifier Technical Specifications) (329 MHz 7kW RF Power Amplifier Technical Specifications) (320 MHz 7kW RF Power Amplifier Technical Specifications) (320 MHz 7kW RF Power Amplifier Technical Specifications) (321 MHz 7kW RF Power Amplifier Technical Specifications) (322 MHz 7kW RF Power Amplifier Technical Specifications) (323 MHz 7kW RF Power Amplifier Technical Specifications) (324 MHz 7kW RF Power Amplifier Technical Specifications) (425 MHz 7kW RF Power Amplifier Technical Specifications) (426 MHz 7kW RF Power Amplifier Technical Specifications) (427 ED0004259 (428 MHz 7kW RF Power Amplifier Technical Specifications) (429 ED0004259 (429 MHz 7kW RF Power Amplifier Technical Specifications) (420 ED0004259 (420 MHz RF Distribution LLRF and Cooling System Seption Power Amplifier ED0001027 (420 MHz RF Distribution LLRF and Cooling System Seption		·	ED0010280			
6 (162.5 MHz 3kW RF Power Amplifier Technical Specifications) ED0010271 7 (162.5 MHz 7kW RF Power Amplifier Functional Specifications) ED0003673 8 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0010278 9 (325 MHz 7kW RF Power Amplifier Technical Specifications) ED0004290 Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 ED0004129 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006356 14 ISD for PIPZIT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIPZIT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment ED0010148 18 Updated Safety by Design Assessment ED0010151 19 Failure Mode Effect Analysis ED0010159 20 Circuit Schematic of HWR ED0010159 21 Circuit Schematic of HWR ED0010283 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	4	HWR RF 7kW Circulator Specifications	ED0010274			
7 (162.5 MHz 7kW RF Power Amplifier Functional Specifications) ED0003673 8 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0010278 9 (325 MHz 7kW RF Power Amplifier Technical Specifications) ED0004290 Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 ED0004129 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0010281 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment ED0010148 18 Updated Safety by Design Assessment ED0010151 19 Failure Mode Effect Analysis ED0010159 20 Circuit Schematic of HWR ED0010159 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model and Release Drawings of SSR1 RF input coupler interface F100949253 Procurement, Production & Installation	5	SSR1 RF 7kW Circulator Specifications	ED0010275			
8 (162.5 MHz 7kW RF Power Amplifier Technical Specifications) ED0010278 9 (325 MHz 7kW RF Power Amplifier Technical Specifications) ED0004290 Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 ED0004129 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006356 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment ED0010148 18 Updated Safety by Design Assessment Table ED0010151 19 Failure Mode Effect Analysis ED0010159 Design 20 Circuit Schematic of HWR ED0010159 Circuit Schematic of SSR1 21 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	6	(162.5 MHz 3kW RF Power Amplifier Technical Specifications)	ED0010271			
9 (325 MHz 7kW RF Power Amplifier Technical Specifications) Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 ED0004129 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006356 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment 18 Updated Safety by Design Assessment ED0010151 19 Failure Mode Effect Analysis ED0010159 Design 20 Circuit Schematic of HWR ED0010283 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	7	(162.5 MHz 7kW RF Power Amplifier Functional Specifications)	ED0003673			
Interfaces 10 Technical Specification for interface HWR ED0002529 11 Fermilab Interface Control Document for SSR1 ED0004129 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006356 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment Updated Safety by Design Assessment Table ED0010151 19 Failure Mode Effect Analysis Design Circuit Schematic of HWR ED0010283 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 Procurement, Production & Installation	8	(162.5 MHz 7kW RF Power Amplifier Technical Specifications)	ED0010278			
Technical Specification for interface HWR Fermilab Interface Control Document for SSR1 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety ED0010276 Risk & Safety ED0010148 Thurst Distribution Risk Assessment Updated Safety by Design Assessment Updated Safety by Design Assessment Table ED0010151 Failure Mode Effect Analysis Design Circuit Schematic of HWR ED0010283 Circuit Schematic of SSR1 ED0010277 Additional Model Overall Design F10109884 AD Model and Release Drawings of HWR RF input coupler interface F10054498 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 Procurement, Production & Installation	9	(325 MHz 7kW RF Power Amplifier Technical Specifications)	ED0004290			
11 Fermilab Interface Control Document for SSR1 12 Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281 13 Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006356 14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems ED0010273 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System ED0010276 Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment ED0010148 18 Updated Safety by Design Assessment ED0010151 19 Failure Mode Effect Analysis ED0010151 19 Failure Mode Effect Analysis ED0010259 Circuit Schematic of HWR ED0010283 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model and Release Drawings of SSR1 RF input coupler interface F10098253 Procurement, Production & Installation		Interfaces				
Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier ED0010281	10	Technical Specification for interface HWR	ED0002529			
Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier ED0006356	11	Fermilab Interface Control Document for SSR1	ED0004129			
14 ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems 15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System 16 Risk & Safety 16 HWR Distribution Risk Assessment 17 SSR1 Distribution Risk Assessment 18 Updated Safety by Design Assessment Table 19 Failure Mode Effect Analysis 20 Circuit Schematic of HWR 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes 23 Overall Design 24 3D Model and Release Drawings of HWR RF input coupler interface 25 3D Model and Release Drawings of SSR1 RF input coupler interface 26 3D Model and Release Drawings of SSR1 RF input coupler interface 27 F10049253 28 Procurement, Production & Installation	12	Interface Specification Document HWR RF Distribution - HWR RF Power Amplifier	ED0010281			
15 ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System Risk & Safety 16 HWR Distribution Risk Assessment 17 SSR1 Distribution Risk Assessment 18 Updated Safety by Design Assessment Table 19 Failure Mode Effect Analysis Design 20 Circuit Schematic of HWR 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes Additional Model 23 Overall Design 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	13	Interface Specification Document HWR RF Distribution - SSR1 RF Power Amplifier	ED0006356			
Risk & Safety 16 HWR Distribution Risk Assessment ED0010148 17 SSR1 Distribution Risk Assessment 18 Updated Safety by Design Assessment Table ED0010151 19 Failure Mode Effect Analysis ED0010159 Design 20 Circuit Schematic of HWR ED0010283 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	14	ISD for PIP2IT HWR RF Distribution LLRF and Cooling Systems	ED0010273			
HWR Distribution Risk Assessment SSR1 Distribution Risk Assessment Updated Safety by Design Assessment Table ED0010151 Failure Mode Effect Analysis Design Circuit Schematic of HWR Circuit Schematic of SSR1 Engineering Calculations and Engineering Notes ED0010277 Additional Model Overall Design F10109884 AD Model and Release Drawings of HWR RF input coupler interface F10054498 BD0010277 F10109885 F10109885 AD Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	15	ISD for PIP2IT SSR1 RF Distribution LLRF and Cooling System	ED0010276			
17 SSR1 Distribution Risk Assessment 18 Updated Safety by Design Assessment Table 19 Failure Mode Effect Analysis Design 20 Circuit Schematic of HWR 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes Additional Model 23 Overall Design 24 3D Model and Release Drawings of HWR RF input coupler interface 25 3D Model and Release Drawings of SSR1 RF input coupler interface 26 3D Model and Release Drawings of SSR1 RF input coupler interface 27 F10049253 Procurement, Production & Installation		Risk & Safety				
18 Updated Safety by Design Assessment Table 19 Failure Mode Effect Analysis Design 20 Circuit Schematic of HWR 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes Additional Model 23 Overall Design 24 3D Model and Release Drawings of HWR RF input coupler interface 25 3D Model of RF Distribution Between Amplifier and HWR Coupler 26 3D Model and Release Drawings of SSR1 RF input coupler interface 27 F10049253 Procurement, Production & Installation	16	HWR Distribution Risk Assessment	ED0010148			
19 Failure Mode Effect Analysis Design 20 Circuit Schematic of HWR 21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes ED0010277 Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface T3 D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 T3 D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	17	SSR1 Distribution Risk Assessment				
Design Circuit Schematic of HWR ED0010283 Circuit Schematic of SSR1 Engineering Calculations and Engineering Notes ED0010277 Additional Model Overall Design Touch Release Drawings of HWR RF input coupler interface Touch Additional HWR Coupler Touch Release Drawings of SSR1 RF input coupler interface Touch Release Drawings of SSR1 RF input coupler interface Procurement, Production & Installation	18	Updated Safety by Design Assessment Table	ED0010151			
Circuit Schematic of HWR Circuit Schematic of SSR1 Engineering Calculations and Engineering Notes ED0010277 Additional Model Overall Design Touch Stribution Between Amplifier and HWR Coupler Stributor Stribution Between Amplifier and HWR Coupler Procurement, Production & Installation ED0010283 ED0010283 ED0010283 ED0010283 ED0010277 Additional Model F10109884 F10109885 F10049253	19	Failure Mode Effect Analysis	ED0010159			
21 Circuit Schematic of SSR1 22 Engineering Calculations and Engineering Notes Additional Model 23 Overall Design 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation						
22 Engineering Calculations and Engineering Notes Additional Model 23 Overall Design 510109884 24 3D Model and Release Drawings of HWR RF input coupler interface 510054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler 510109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface 610049253 Procurement, Production & Installation	20	Circuit Schematic of HWR	ED0010283			
Additional Model 23 Overall Design F10109884 24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	21	Circuit Schematic of SSR1				
23Overall DesignF10109884243D Model and Release Drawings of HWR RF input coupler interfaceF10054498253D Model of RF Distribution Between Amplifier and HWR CouplerF10109885263D Model and Release Drawings of SSR1 RF input coupler interfaceF10049253Procurement, Production & Installation	22	Engineering Calculations and Engineering Notes	ED0010277			
24 3D Model and Release Drawings of HWR RF input coupler interface F10054498 25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation						
25 3D Model of RF Distribution Between Amplifier and HWR Coupler F10109885 26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	23	Overall Design	F10109884			
26 3D Model and Release Drawings of SSR1 RF input coupler interface F10049253 Procurement, Production & Installation	24	3D Model and Release Drawings of HWR RF input coupler interface	F10054498			
Procurement, Production & Installation	25	3D Model of RF Distribution Between Amplifier and HWR Coupler	F10109885			
·	26	3D Model and Release Drawings of SSR1 RF input coupler interface	F10049253			
27 RF Circulator Verification Test Document ED0010285						
	27	RF Circulator Verification Test Document	ED0010285			