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# Power Supply System for DRFS

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# Design of Power Supply System for DRFS

Failure rate ~13 times go up

**Parallel Connection System for 13 Klystrons** → **Low Availability**

To realize high available system capable of continuous operation, which should be high-reliability and low cost

## Main Features

1. Use of switching Power Supply to charge the capacitor bank
2. One common dc power supply with a bouncer circuit and one common modulation anode modulator
3. Redundancy of one unit for switching power supply and modulation anode modulator (Backup system)
4. Individual HV relay and CT monitor for all klystrons to separate the failed klystron from the system

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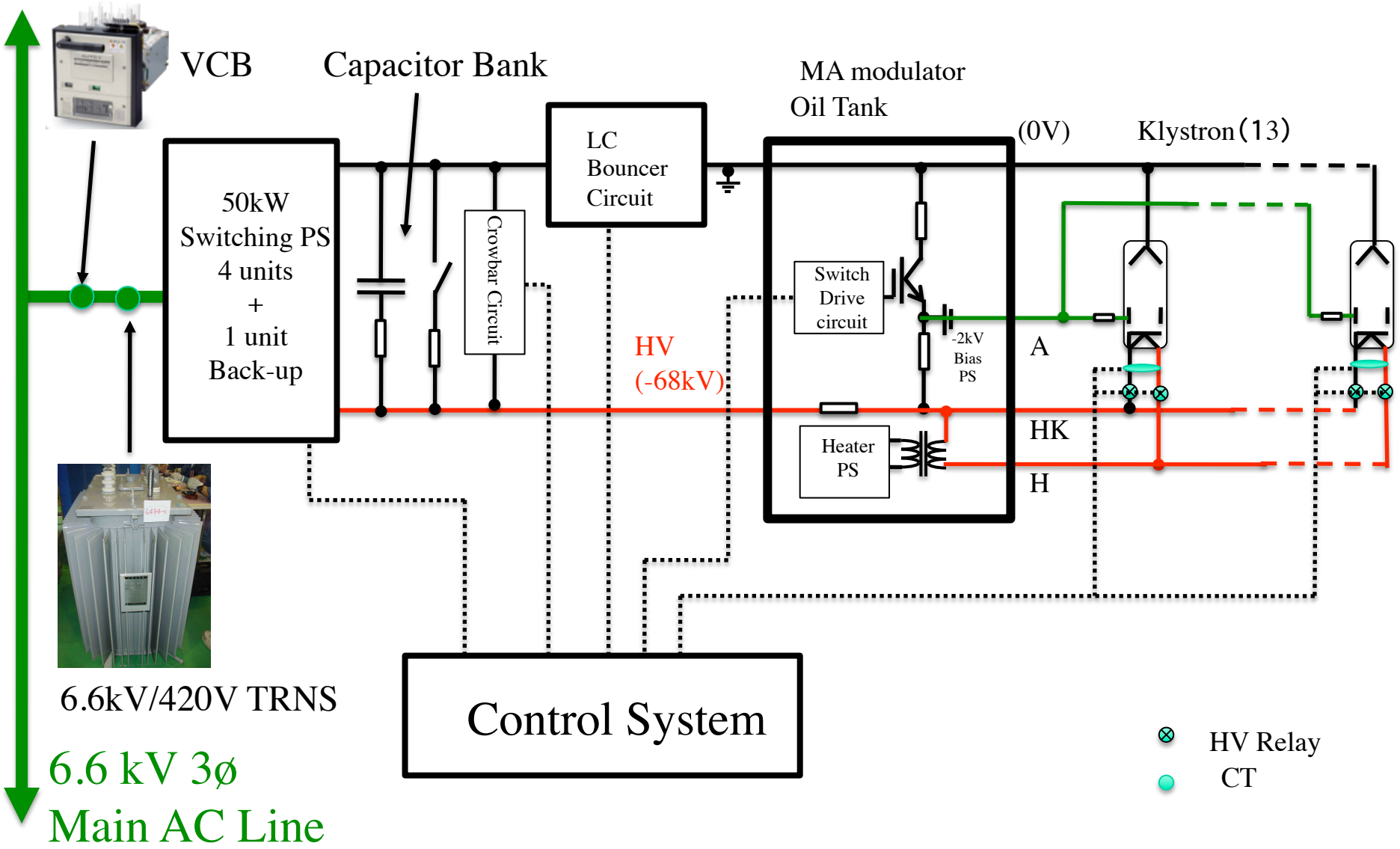
# PS system for DRFS (one unit)



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# Design Parameters of PS system for DRRF (one unit)

## MA L-band Klystron

| | |
|---|---|
| Frequency | 1.3 GHz |
| RF Peak Power | 750 kW |
| RF Pulse Width | 1.5 ms |
| Repetition Rate | 5 Hz |
| Efficiency | 60% |
| Beam Perveance | 1.2 $\mu$P |
| Cathode Voltage | 64.1 kV |
| Cathode Current | 19.5 A |

## Switching Power Supply

| | |
|---|---|
| # of Switching PS | 5 |
| Output Power | 50 kJ/s |
| Output Voltage | 70 kV |

Cathode Power Supply per 3 cryomodules
In Case of a droop of 10%.

| | |
|---|---|
| # of Klystron | 13 |
| Cathode voltage | 68 kV |
| Average Current | 2.3 A |
| Output Power | 165 kW |
| Peak Pulse Current | 254 A |
| Pulse Width | 1.7 ms |
| Repetition Rate | 5 Hz |
| Capacitor Bank | 67.2 $\mu$F |

## M Anode Modulator

| | |
|---|---|
| # of MA Modulator | 2 |
| Anode Voltage | 53 kV |
| Anode Bias Voltage | -2 kV |
| Pulse width | 1.5 ms |

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# Droop compensation using a Bouncer Circuit

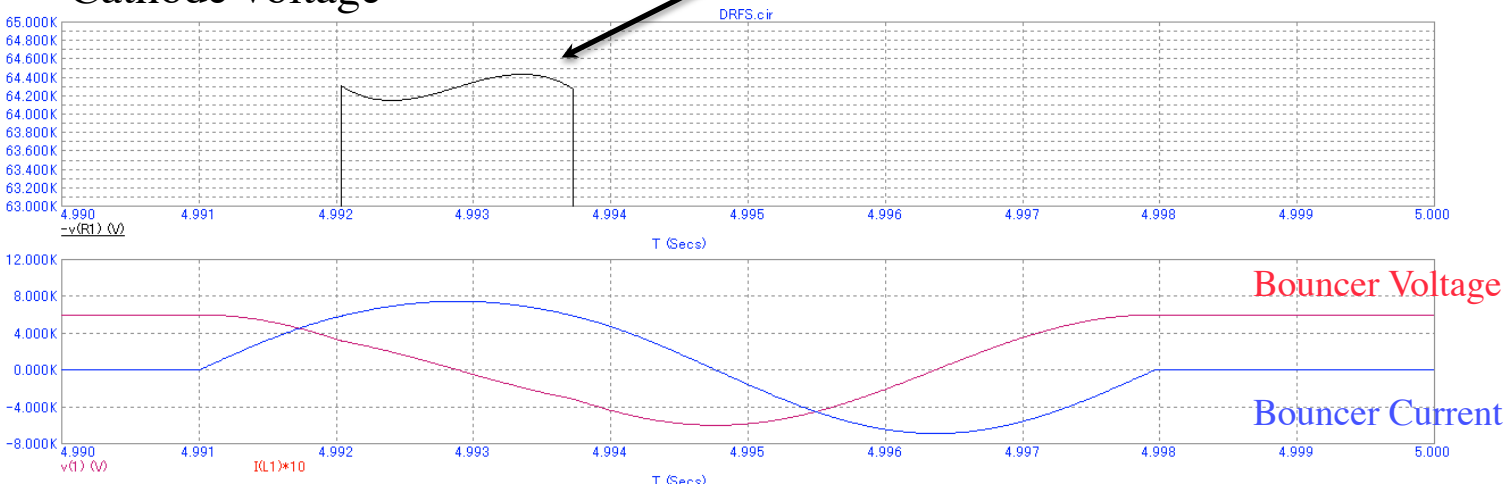
## LC Bouncer Circuit

| | |
|---|---|
| Inductance | 8.9 mH |
| Capacitance | 33.8 $\mu$F |
| Period | 6.4 ms |
| Peak Current | 750 A |
| Peak Voltage | +-6 kV |

- Reduce total size of dc and ac capacitors
- 10 % droop design is 20% lower than 20 % droop design

Flat-top Flatness = 0.5%

Cathode voltage



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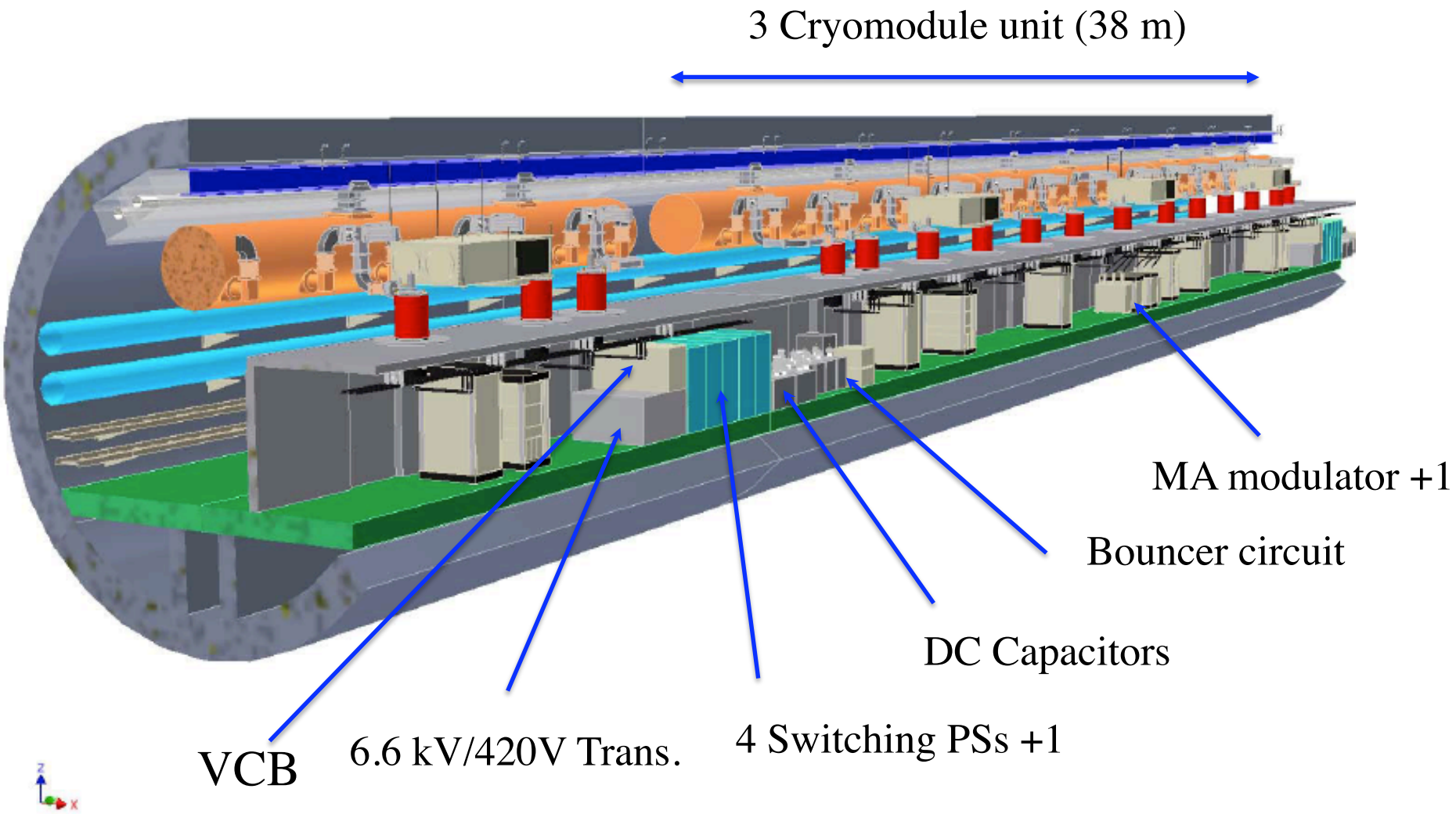
# DRFS Tunnel Layout




# PS System for S1-Global DRFS

- Demonstration of DRFS system with 2 klystron loads.
- To rapidly study the system and reduce its cost,
  - No Bouncer circuit
  - Use of a thyratron switch as a crowbar circuit
- Five Switching PSs are used as a capacitor charger.
- A droop of 5% is designed for 2 klystron loads.
- MA modulator is based on J-Parc design.
- MA switch uses series IGBTs.

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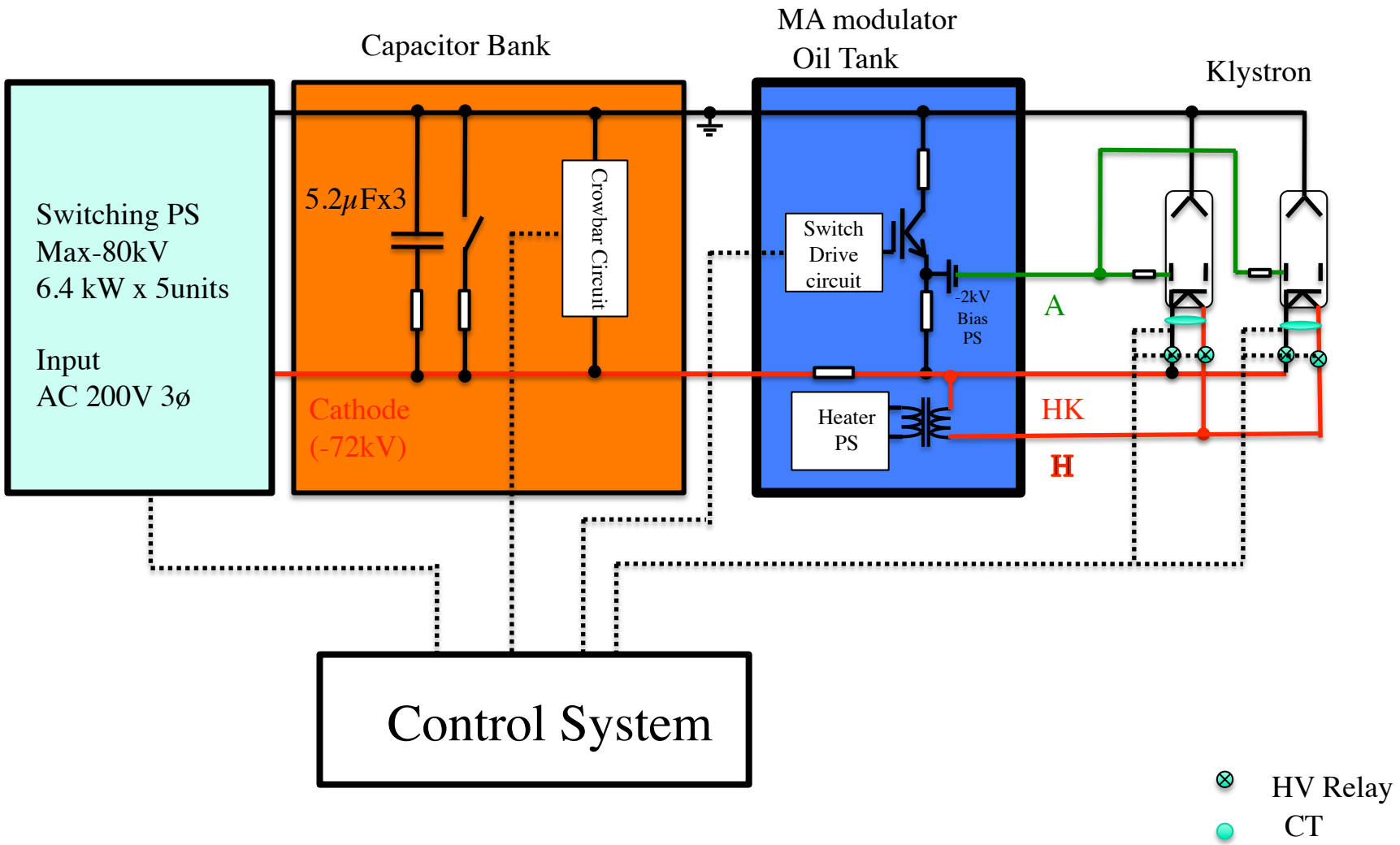
# PS System for S1-Global DRFS



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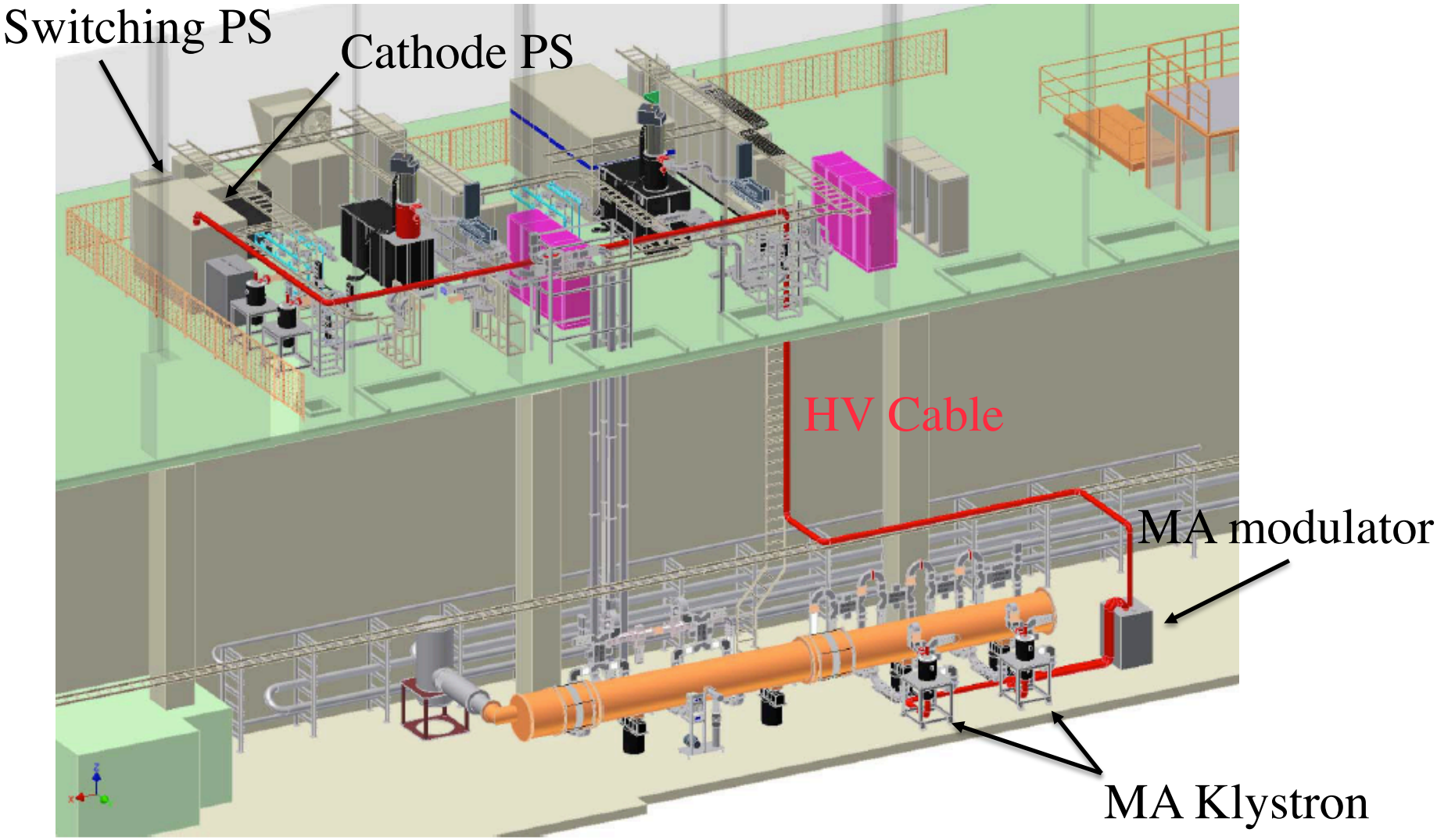
# PS Set-up for S1-Global DRFS at STF



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# R&D of Power Supply for DRFS

•HV Relay Test and Development

70kV HV Relay

- SF-6 gas filled
- Max current 10 A
- Operate time 20 ms
- Life 0.5 million
- Weight 336 g
- Coil 28Vdc, 1A


GIGAVAC G71L

•Long HV Cable test

•Crowbar circuit

Cost down using gap switch

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# Summary

- Proposal of PS system for DRFS is presented.
- A prototype power supply for S1-Global is under construction and will be completed in October.
- The first PS system for DRFS will be evaluated in S1-Global test.