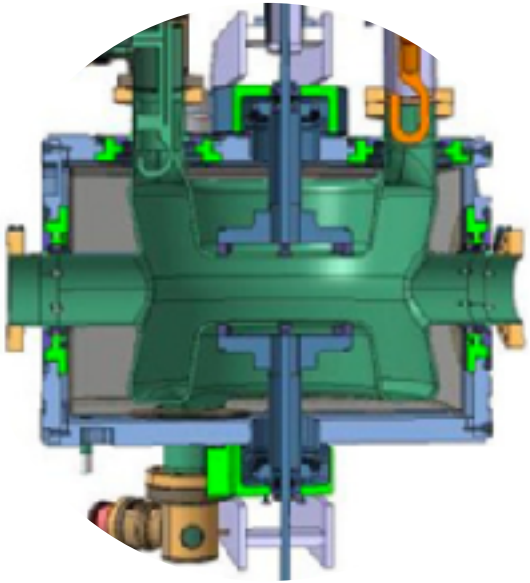
DQW series production

HL-LHC Collaboration Meeting, 13-16 Nov 2017,
CIEMAT, Madrid

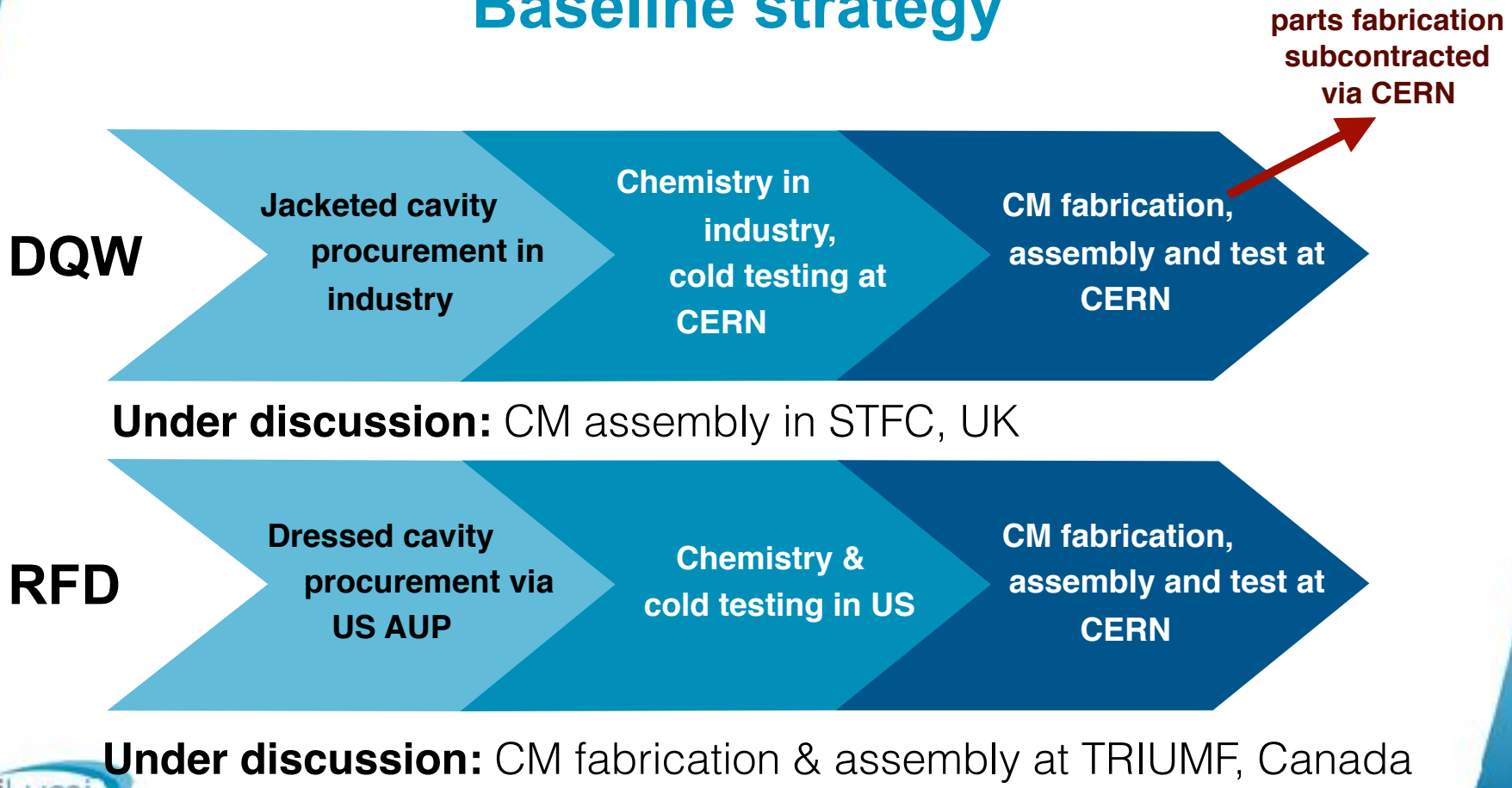
Frank Gerigk, CERN

Contents



- Baseline strategy DQW/ RFD
- CERN work load
- DQW tendering
- CERN infrastructure

Baseline strategy



CERN workload

Minimum workload

- DQW couplers,
- 20 DQW bare & dressed cavity test (1/21 - 5/22) + re-tests (30-50%),
- DQW CM parts subcontracting,
- DQW & RFD CM cold test,

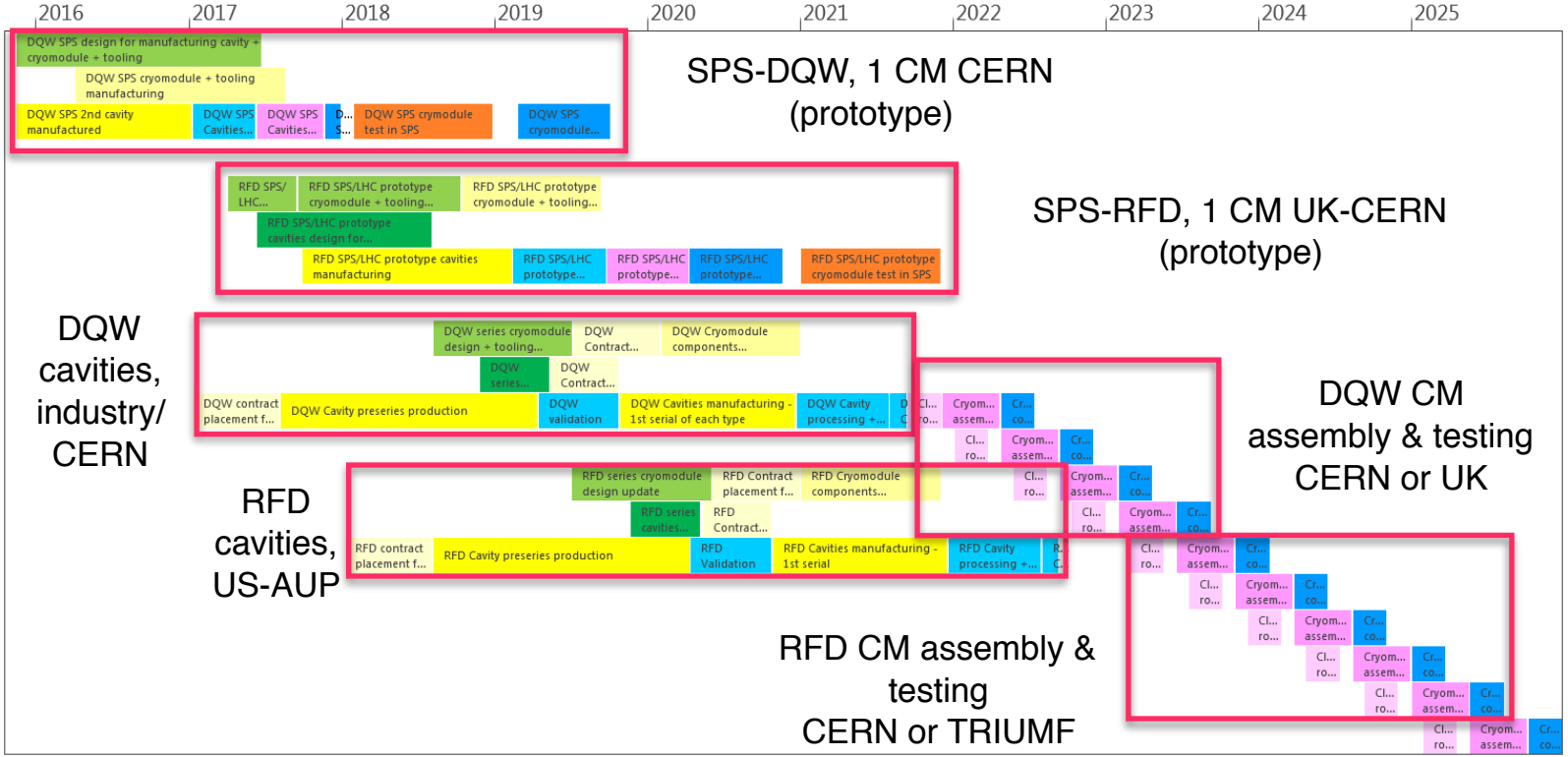
Maximum workload

- DQW couplers,
- 20 DQW bare & dressed cavity tests (1/21 - 5/22) + re-tests (30-50%),
- **DQW CM fabrication & assembly,**
- **RFD CM fabrication & assembly,**
- DQW & RFD CM cold test,
- **+ back-up for failures, or delays in cavity production (or couplers, He-tanks, …)**

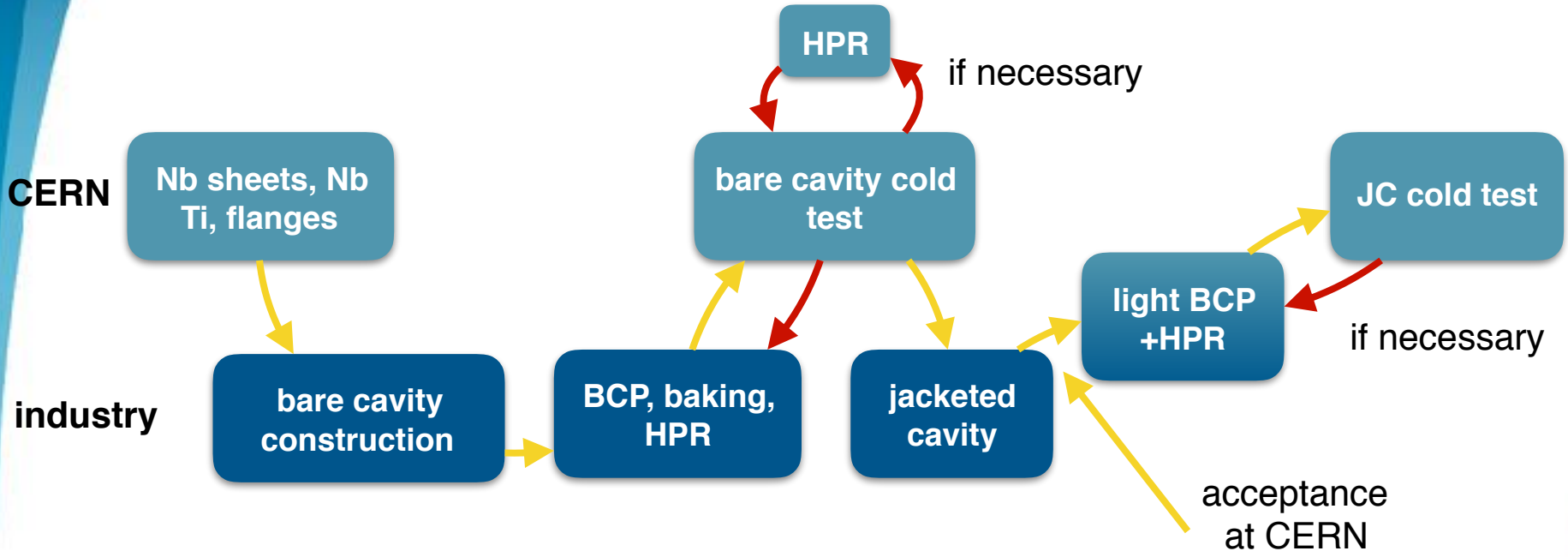
Assumption for today: trailing of DQW CM & RFD CM assembly & testing at CERN Infrastructure will be prepared to handle the complete series (but that may mean to stop/delay other activities).

Baseline: RFD + DQW CM assembly at CERN

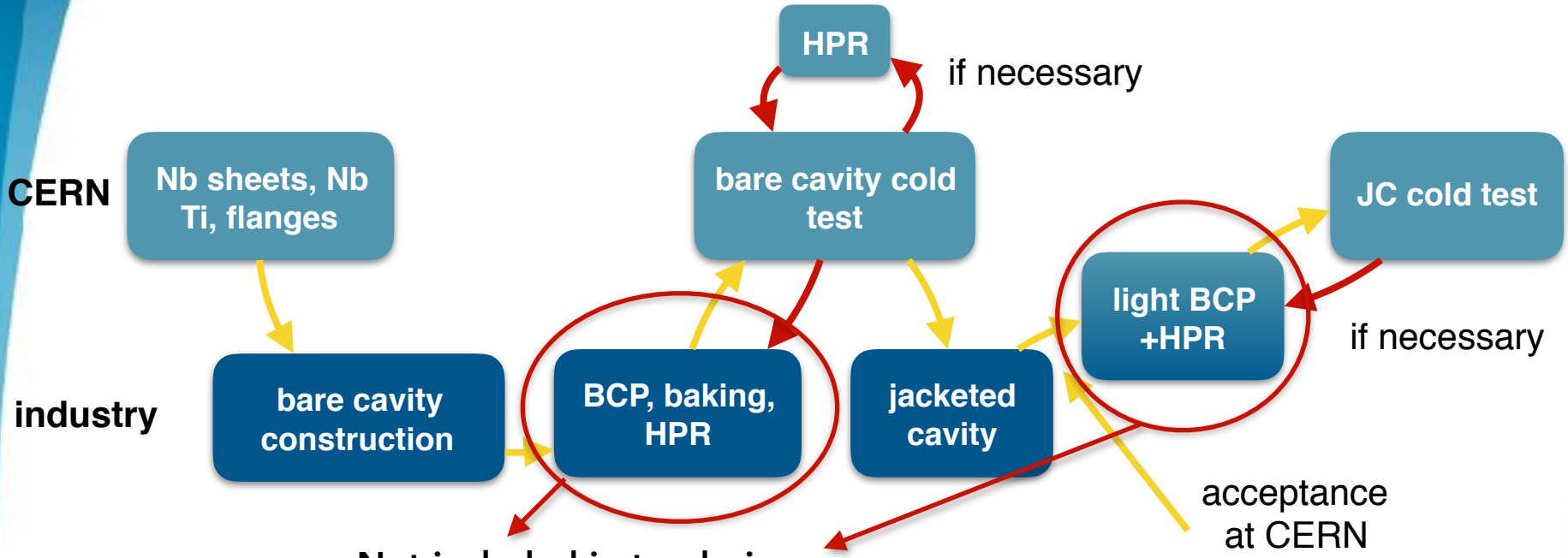
Assumption: Max. work load



DQW cavity work flow



DQW cavity work flow



Not included in tendering:

- Re-treatment of cavities (HPR) in case of field emission,
- light BCP + HPR after jacketing

Both could be done at CERN or added to the contract

DQW tendering

Included in tendering:

- One jacketed cavity as pre-series;
- 10 JCs as series for installation;
- Processing (BCP, HPWR, heat treatment);
- Jacketing: He tanks/pre-tuning system;
- JC assembly & welding;

Provided by CERN

- Niobium sheets and Niobium-Titanium;
- magnetic shields for inside He-tank;
- flanges (3D forged 316LN);
- cold test of bare cavities;
- cold test of jacketed or dressed cavities;
- manufacturing file of DQW prototype;

There is no guarantee on performance of the cavities. Acceptance criteria are:

- Dimensions within specifications;
- Resonance frequency at 300 K in air within ±100 kHz of target frequency;
- Process & inspection tests according to specified standards (e.g. welds, cutting fluids, cutting temperature, brazing, heat treatment, HPWR, …);
- Leak tightness;
- Surface quality;

Tender was closed 2 weeks ago, contract in preparation

CERN SRF infrastructure

The SPS prototype assembly was (so far) successful, but…

- the existing infrastructure was set up for LHC cavities, HIE-ISOLDE cavities, & 704 MHz multi-cell elliptical cavities, and adapted “on-the-fly” for the crabs,
- it involved many “creative” solutions, which are not suitable for a large series: tooling not ready, procedures not fully developed/ tested, HPR, etc.
- the cold testing speed is too slow,
- the Crab CM assembly station is blocking part of the LHC CM assembly area,
- space for reception, acceptance, storage was non-existent,

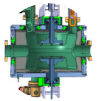
Infrastructure: vertical cold tests

The DQW series requires a total of 26 to 30 cold tests with ~ 2 cold tests/months. If the RFD is done completely externally more time can be used for testing.

2x  Today's capacity

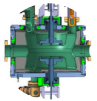
2 cold test/month:

- 1 compatible vertical cryostat,
- 1 day for connection & cool-down,
- 1 week for conditioning & measuring,
- 4 days warm up,

1x  Today's actual throughput

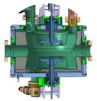
1 cold test/month:

- fixing of leaks, etc.
- maintenance periods,
- helium availability,
- availability of people (no dedicated cold test team),,

8x  Future capacity

8 cold test/month:

- **2** compatible vertical cryostats,
- 1 day for connection & cool-down,
- 3.5 days for conditioning & measuring,
- ➡ movable tuner for faster conditioning,
- ➡ faster warm up,

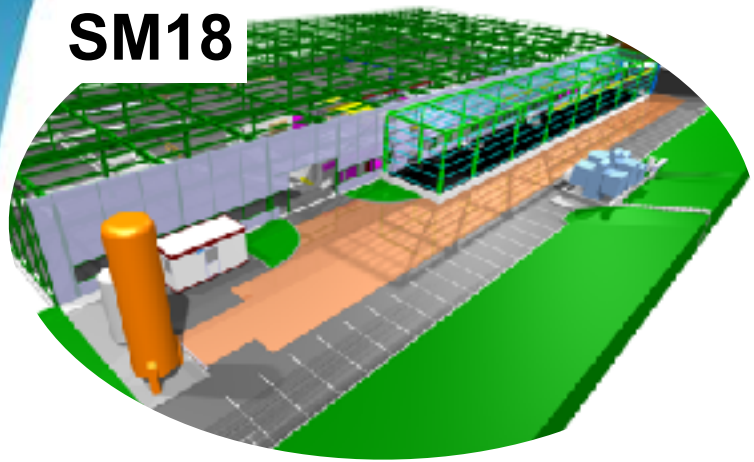
4x  Future realistic throughput

4 cold test/month:

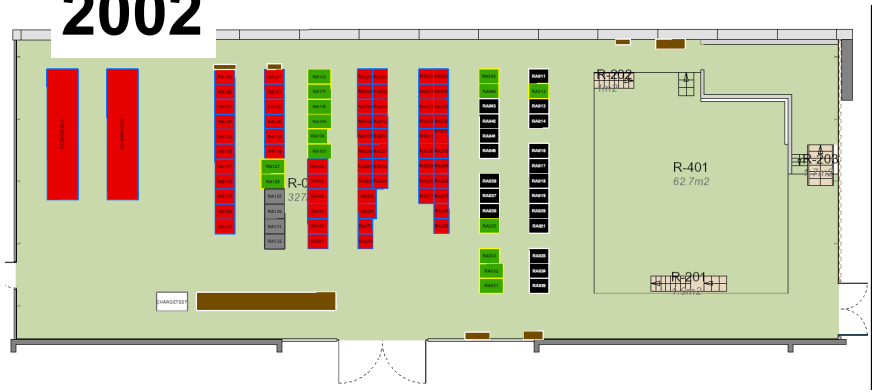
- fixing of leaks, etc
- maintenance periods,
- helium availability,
- ➡ dedicated cold test team,

Space: SM18 extension, 2002

SM18



2002



- SM18 extension: Space for a dedicated Crab CM assembly station & tooling.
- Start of construction: Jan/Feb 2018; completion: summer 2018; services installations: end 2018; RF specific installations from 1/2019 onwards.
- 2002: transformation into a SRF reception, acceptation, storage area

SRF infrastructure upgrade

Being discussed right now, for a period of ~3 years, the highlighted items are needed for a crab cavity program (but will also benefit all other SRF activities)

	timeline	cost estimate	needed for
2 CM assembly stations in SM18 extension	2019	~100 kCHF	Crabs, R&D CM
Bld. 2002 refurbishment	2018/2019	~250 kCHF	conversion for SRF storage
New HPR	2019/2020	~750 kCHF	Crabs, LHC/FCC type, larger cavities
Improved HPR in 252 for coated cavities	2018	~50 kCHF	LHC, HIE-ISOLDE, R&D
New mobile clean room 252	2018/19	400 kCHF	LHC, HIE-ISOLDE, R&D
improved storage in 252, shelves, platform	2018	200 kCHF	all
Storage platform on SM18 control room	2018	70 kCHF	all
252 consolidation (floor, roof)	2018/19	50 kCHF	all
Improved He handling in SM18	2019	~100 kCHF	faster cool-down/warm-up
2nd R&D cryostat (cryo-lab type)	2019	~30 kCHF	R&D
shielding consolidation/access system SM18 bunkers	2019	~200 kCHF	all
Controls consolidation SM18 RF	2018/19	~50 kCHF	all
Dedicated oven for Nb heat treatment	2018/19	~1 MCHF	Crabs, R&D, all bulk Nb cavities
FPC instrumentation, tools, storage	2019/20	120 kCHF	all
Totals	2018 - 20	3 - 3.5 MCHF	

Manpower

- A new clean room technician (BE-RF) has been hired.
- Hiring of a mechanical engineer in BE-RF to follow the series production of the DQW is ongoing.
- Very successful collaboration with HNINP Krakow, Poland for the SPS prototype: 4 project associates are at CERN for 1.5 - 2 years: 2 in EN-MME, 2 in BE-RF, for fabrication support, assembly, cold testing. Interest on both sides to continue. This can be a model for the assembly and testing of a series.

Summary

- The concept for DQW string assembly and cryostating has been proven with the SPS prototype (even with incomplete set of tooling).
- Both DQW CERN cavities & the US DQW cavities have performed beyond specifications during vertical cold tests.
- The lessons learned will be applied and the tools will be completed/ optimised.
- SRF infrastructure at CERN is starting and will provide the capability for full series testing & assembly. However, the full series would largely block the CERN SRF capacity for at least 3 years.
- Collaborations in addition to US-AUP (Canada/UK) are under negotiation.
- DQW tendering completed, contract signature imminent.

Module on it’s way to the bunker


and on it’s jacks