research instruments

TTC meeting 2022 – WG 1: Challenges of Global Collaboration

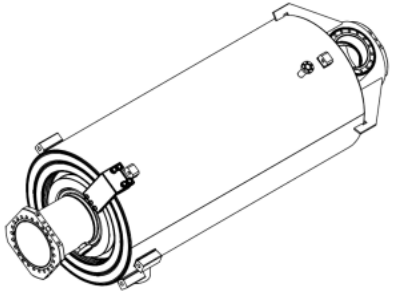
Challenge and issues in worldwide projects: experience from RI Research Instrument GmbH

Daniel Trompetter on behalf of the SRF Team at RI.

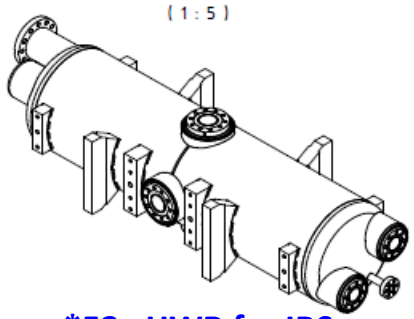
Content

- Brief overview on RI activities
- Dealing with international customers
- Dealing with collaborating partners (not direct customer)
- Impact of the different pressure vessel regulations on manufacturing and certification processes
- Transportation of SRF components

SRF cavity production at RI in 2021 and 2022

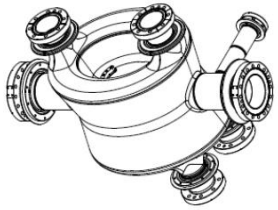


*88x ESS high beta for UKRI

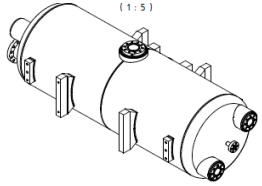


*52x HWR for IBS project

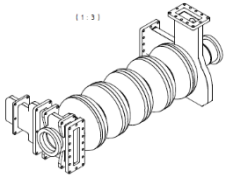
*30x PPU cavities for ORNL



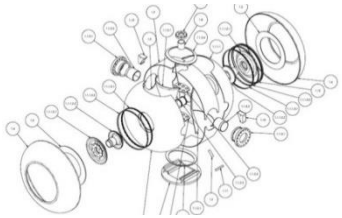
*9x crab cavities for CERN



29x HWR for CEA/SARAF



16 x C75 cavities for JLAB



*2 SSR2 spoke for IBS

Additional about 170 Tesla type cavities and other prototype cavities

About 160 cavities per year are produced at RI in 2021 and 2022

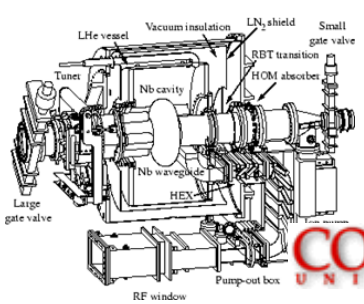
***Scope includes surface preparation (BCP/EP, HPR, cleanroom assembly)**
Only mechanical manufacturing

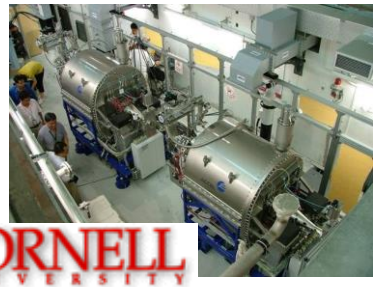
SRF modules produced at RI

500 MHz (Cornell University, USA)

2 SRF modules	for NSRRC,	Taiwan
2 SRF modules	for CORNELL,	USA
3 SRF modules	for CLS,	Canada
4 SRF modules	for DLS,	Great Britain
3 SRF modules	for SSRF,	PR China
4 SRF modules	for PAL,	Korea
2 SRF modules	for CNPEM	Brazil

Total 20 SRF modules





1.3 GHz (Rossendorf / XFEL)

2 SRF modules	for Daresbury,	Great Britain
2 SRF modules	for Ankara,	Turkey
2 SRF modules	for Mainz,	Germany
4 SRF modules	for PolFEL,	Poland

Total 10 SRF modules

New 60 m^2 ISO 4 clean room commissioned for high quality PolFEL and LightHouse cryomodule assembly

International customers - communication

Communication intensity is depending on the type of project.

„Defined“ components
(cavity, FPC, HOM-damper)

„Standard products“
e.g. TESLA cavities
e.g. TTF-III FPC

Modified standard products
with minor modifications, e.g.
- RF parameters
- Surface treatment
- Mechnical design

- Quote & Order on existing specification
- Regular status meetings / reports
- Documentation
- Established delivery conditions

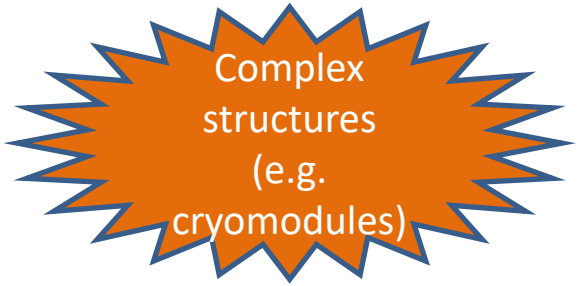
- Adaptation of technical specification ?
- Simulations / Samples ?

International customers - communication

Projects with more complexity add more communication items.

- On-line QA and documentation
- Parts-in-circulation
- Delivery rates / schedule

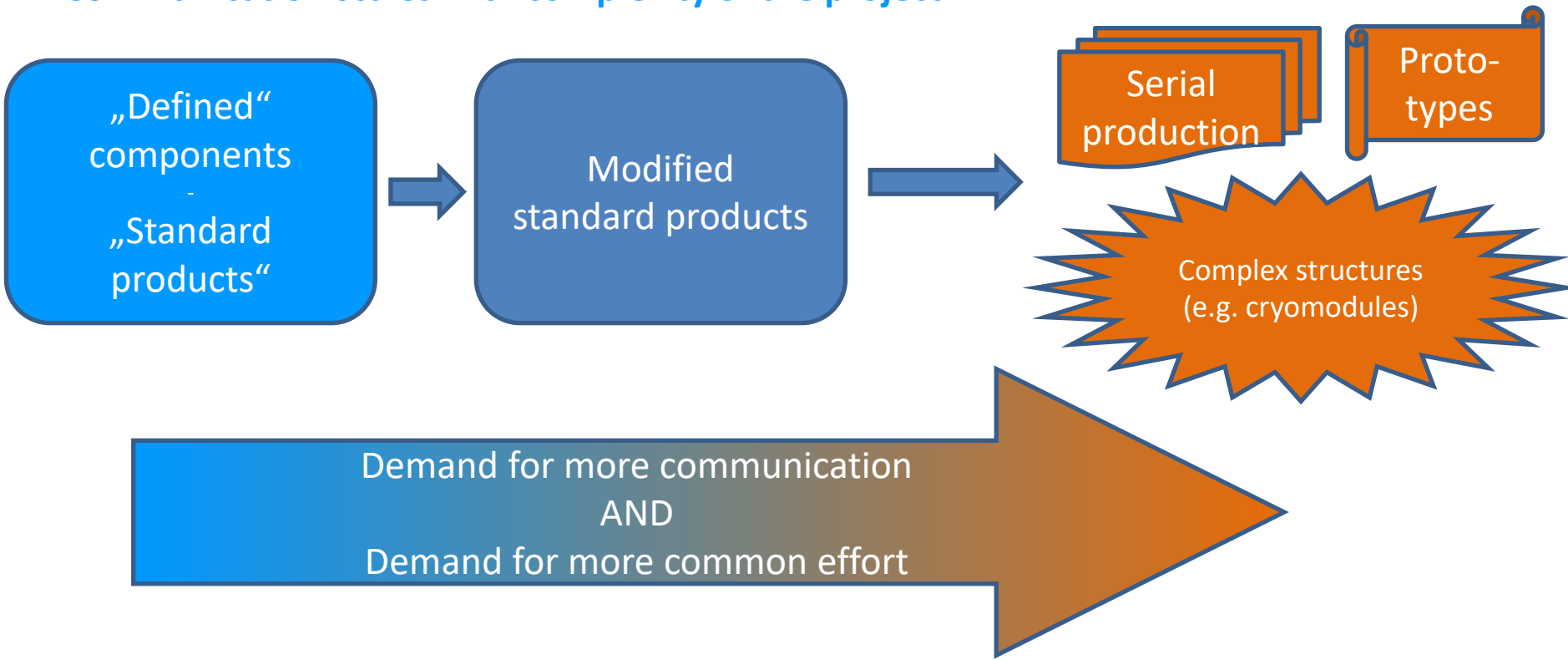
- Design phase
  - RF recipe
  - Cryogenic environment
  - Mechanical properties
- Feasibility study ?
- Design Reviews
- On-line samples / trials
- Data acquisition



- Design phase / customization
- Interfaces
  - RF supply
  - Cryogenic supply
  - Control system
- Single components tests
  - Cavity
  - FPC / RF windows
- FAT
- Installation and SAT

International customers - communication

Communication scales with complexity of the project



International customers - communication

Personal meeting for building a basement

- The more complex or undefined a project will be:
  - the higher the demand on communication and common effort.
  - the more open and trustful the communication of the project partners is required.

- From RI experience, a personal meeting during an early stage of the project is important to build up a baseline level of trust and to find common understanding of the project goal.

→ *During project execution, it is far easier to contact someone you know already!*

- In addition, common activities (e.g. review meetings, component testing, commissioning) are helpful to strengthen the level of trust and gaining common understanding!

Dealing with international customers

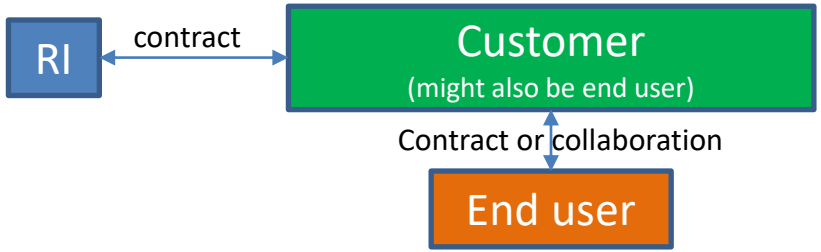
Cultural barriers and current situation

- The above mentioned is valid for customer and partner relations worldwide.
  But: The larger the cultural difference, the more communication might be required to gain common understanding, even for standard products.
  The support of a qualified partner can be helpful to overcome cultural barriers.

- The COVID19 pandemic taught us:
  - (+) That a personal visit is not required for many occasions (e.g. review meetings).
  - (-) That an initial personal meeting cannot be replaced by virtual meetings at all.

Collaborating partners

Sequential relation

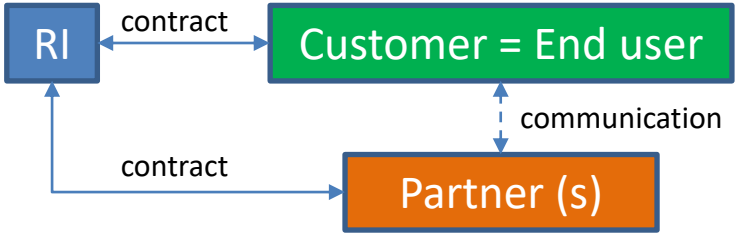


For example: IFMIF cryomodule assembly

- RI ↔ F4E ↔ QST
- RI and F4E have a contractual relationship.
- F4E and QST are in a collaboration (both end users).

Communication is usually done from one entity to the next.

(Multi) partner relation



For example: CESR-B cryomodules
(like PAL, CLS, SIRIUS, etc.)

- RI ↔ Customer (=end user)
- RI ↔ Cornell University (cavity test)
- RI ↔ DESY (RF window test)

Communication is mainly done through RI, but also between RI‘s partners and the customer.

Collaborating partners

Relation	Advantages	Disadvantages
Sequential	The customer knows the partner better and can „filter“ any kind of information.	Relay communication can increase response time. No direct contact with end user to gain common understanding.
Multi partner	The experience of the partners help to gain trust in RI‘s work and quality.	Stakeholder management is more complex.
Both	The customer or partner can help to overcome cultural and language barriers.	

Pressure vessel code

Impact of the different pressure vessel regulations on manufacturing and certification processes

Europe: Helium vessels operated ≥ 0.5 bar (gauge)

→ pressure equipment according to the European Pressure Equipment Directive (PED 2014/68).

RI has been certified by a notified body (TÜV Nord) to build equipment according to the European PED, following the AD2000 code, **BUT:**

Since SRF cavities form a wall of the pressure equipment, and Niobium is not classified by EN13445 nor AD2000, they are not automatically covered by the codes!

- → A cavity or cryomodule design (operating at ≥ 0.5 bar g) requires a design which is approved by a notified body (depending on classification).
- → The approval process for larger volumes is complex and can take long time.
- → Several examinations and destructive testing of a cavity with Helium vessel under witness of the notified body might be involved.

TÜV NORD

CERTIFICATE

TÜV NORD Systems GmbH & Co. KG

certifies that the company

RI Research Instruments GmbH
Friedrich-Ebert-Str. 75
51429 Bergisch Gladbach

has been verified and recognized as manufacturer of

Pressure equipment parts for components and systems for particle accelerator constructions, constructions for science, power engineering and industry

according to the rules of

AD 2000-Merkblatt HP0

Certificate-No.: 07/203/1403/HP/3146/19

The range of validity and details of the inspection can be taken from our Report-No.: / SAP-No.: 8117523637

The company has established a product-related quality system together with personnel and equipment which ensures manufacturing and testing corresponding to the technical rules.

This certificate is valid until

10/2022

Hagen, 29.10.2019 / jk

Stolz

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RI can support during this process with knowledge and experience.

Option for consideration: Define the vacuum vessel to be the pressure boundary!

→ Can save time and budget!

Pressure vessel code

Impact of the different pressure vessel regulations on manufacturing and certification processes

Europe - responsibilities:

Example: European XFEL

The project has shown a possible way of collaboration:

- DESY being the “manufacturer” according to PED:
  - Responsible for the design and approval process.
  - Responsible for material certification and documentation.
- Cavity manufacturers (RI and EZ) being “site of manufacturing”:
  - Manufacturing, testing and documentation in strict accordance to DESY specification.
  - Manufacturing surveillance by notified body (ordered by DESY), supervision of visual inspections and pressure testing of the cavities and Helium vessels.

Pressure vessel code

Impact of the different pressure vessel regulations on manufacturing and certification processes

Non-European pressure vessel codes:

- Many different authorities and codes (ASME/CSA, NLab codes, Japan, Korea Gas Safety, etc.)
- Almost impossible to receive certification for all of them.

→ RI is not certified, but does / can support in similar way:

<u>Customer is the manufacturer</u>

responsible for design and approval of the equipment against the local authorities.

<u>RI performs</u>

the manufacturing, testing and documentation according to customer specification, under inspection of a notified body (representing the customer).

Final inspections by authority inspectors at RI are possible.

Pressure vessel code

Impact of the different pressure vessel regulations on manufacturing and certification processes

Important: (EB-)welding qualification

- The (EB-)welding qualification has to be done during the MRR process in collaboration with the local authorities.

→ Contact your notified body in an early stage of your design to discuss the required scope of the testing and certification.

→ Do not underestimate time and budget for the design certification by your notified body!

- The material for the qualification samples (often) shall be from the same lot of material and identical dimensions!

→ Order enough material for components AND welding qualification samples!

Transportation issues

The more complex the component, the more care is required for transportation:

- Single components (e.g. cavities, FPC, …) can be packed in suitable boxes.





- Shock recorder are used, interpretation of results is difficult.
- Type of box and suspension has to be matched to component, distance and way of shipment (door-to-door, general cargo (mis-)handling). Handling interface to be defined!
- Re-usability (serial productions) has to be taken into account.

Transportation

The more complex the component, the more care is required for transportation:

- Complex equipment (e.g. cryomodules) requires a proper designed transportation device (e.g. spring loaded shock absorbers).

  - Shock recorder shall be used.
  - Re-usability depends on return cost and time.

Transportation

Cargo attendance on sensitive shipments

- Personal cargo attendance can help to reduce mis-handling.
- It cannot help to prevent accidents, but at least you can react immediately.

Events like 9/11, the Brexit and the current COVID19 pandemic made it more and more difficult to attend the shipments door-to-door.

Thank you!

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Thank **you** for your attention!

Thanks to Alexander Navitski, Michael Pekeler and Jörg Zeutschel for their input.