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CCDTL 5th technical meeting for production of 7 CCDTL modules for Linac4 (ISTC contract #3888 and #3889), 20-21 July 2010 at VNIITF

Participants:

BINP Novosibirsk: Alexey Tribendis (ISTC Projects 3888/89 manager, deputy RF group leader BINP)

VNIITF Snezhinsk: Yury Kretinin (Technologist), **Vladimir Lomakin** (Production Supervisor), **Mikhail Naumenko** (ISTC Projects 3888/89 sub-manager, design group leader VNIITF), **Gennady Ostashkov** (Technologist), **Georgy Rykovanov** (Director of VNIITF), **Ilya Semenov** (Technologist), **Dmitri Shadrin** (Design Engineer), **Boris Sidorov** (Leading Technologist), **Vadim Simonenko** (Scientific project leader at VNIITF), **Peter Tushkanov** (Technologist), **Dmitry Vavasov** (Design Engineer),

CERN: Frank Gerigk (ISTC Projects 3888/89 coordinator at CERN, responsible for accelerating structures in Linac4), **Tadeusz Kurtyka** (Project Office, External Relations), **Maurizio Vretenar** (Linac4 Project Leader)

List of talks

Indico meeting 104590

Supporting documents in EDMS

- drawings for 2nd welding test: EDMS document 1094582
- results of 2nd welding test: EDMS document 1083982 (restricted access)
- 3D drawings of support jacks EDMS 1083986
- 2D examples drawings of PIMS water splitters EDMS 1083973

Technical summary

1. Status at BINP
2. Status at VNIITF
3. Welding of cooling channels
4. Coordinate systems & metrology
5. Copper for fixed tuners
6. Water manifolds & support jacks
7. Water connections
8. Support frame
9. Action list

The meeting was opened with a status report on Linac4 by M. Vretenar.

1. Status at BINP

Presentation by A. Tribendis: Slides in Indico

- presentation of project scope and organisation,
- technical description of machining and assembly steps,

- description of drift tube alignment technique,

status of works:

- rough machining of drift tube body parts is done,
- cooling channels in the centre part are done on one side,
- aluminium drift tubes for frequency tuning are ready,
- drift tube installation and alignment tools are ready,
- assembly table is ready,
- waveguide parts are being machined at present,
- brazing of drift tubes and stems starts in August,
- 3 laser tracker target holder pads have been added to the design of each drift tube,

The construction sequence at BINP was discussed and has the following steps:

1. Check cavity dimensions on a CMM
2. Assemble and measure each tank with a few sets of aluminum drift tubes, find correct final dimensions of copper drift tubes.
3. Do final machining of copper drift tube bodies. EB-weld suspension stems to the bodies.
4. Assemble and measure each tank with copper drift tubes (properly aligned), find correct final dimensions of fixed tuners.
5. Do final machining of AC fixed tuners.
6. While machining and welding drift tubes, measure coupling cells frequencies.
7. Machine coupling cell shell to bring the frequency into the tuning range.
8. Repeat coupling cell frequency measurements and find correct final dimensions of fixed tuners.
9. Do final machining of CC fixed tuners.
10. Assemble the entire module, check the tuning, measure field flatness, Q, find the right position of waveguide short.
11. Assemble the module with Helicoflex gaskets, perform vacuum leak tests.
12. Do 16 bar water tests, measure WFR for individual water cooling channels.
13. Dismount drift tubes from cavities, prepare for shipment to CERN.
14. Negotiate with ISTC for shipment (and Customs) arrangements.

2. Status at VNIITF

Presentation by Y. Kretinin: Slides in Indico

- description of manufacturing cycle, which has been optimised to minimise any deformation of the half tanks,
- procedure for drilling of cooling channels has been optimised to avoid leftover metal chips on the inside,
- description of tests,
- transport procedure: assembled single cavities are put on a transport frame and each cavity will be packed in a plastic bag, which is filled with dry nitrogen,

status of works:

- 18 half tanks are pre-machined,
- 2 half tanks are rough machined and the cooling channels are welded,
- first copper plated half tank will be delivered to BINP beginning of September,
- first complete module will be at BINP at the end of September,

3. Welding of cooling channels

Presentation by F. Gerigk: Slides in Indico

Qualification of 2nd welding test according to ISO5817 level B: EDMS document 1083982 (restricted access)

Qualification of 2nd welding test:

Welder 1:

- Part 1: Excessive distortion + stray arc + shrinkage cavity could be observed.
- Part 2: No weld imperfection could be observed, probable presence of martensite on 304L tube.
- Part 3: Penetration between 1.8 mm and 2.2 mm.
- Part 4: Penetration of 2.6 mm, root oxidation + lack of fusion could be osberved.

Welder 2:

- Part 1: Excessive distortion + stray arc + shrinkage cavity could be observed
- Part 2: Full penetration on inner tube, root oxidation could be osberved.
- Part 3: Penetration between 2.1 mm and 2.4 mm
- Part 4: Penetration between 2.9 mm and 3.1 mm

Result: Root oxidation and lack of fusion are not permitted according to level B of ISO 5817.

Even though the weldings do not fulfil level B of the norm, they are considered as adequate for the CCDTL water channels. One improvement is requested to avoid oxidation at the welding roots: In the previous welds solid copper pins have been used to remove the heat from the cooling pipes and to keep the pipes in place. These should be replaced by using hollow copper pins, which allow circulation of protective gas (e.g. Argon) to avoid oxidation.

Discussion of the already machined tanks:

- on the inside of the machined tanks one can see traces of the welding of the circular cooling channels,
- a photo is requested so that CERN can discuss whether this will have any influence on the copper plating,
- it was decided to reduce the welding thickness for the cooling channels from 3 to 2 mm, for the remaining pieces,
- the first module will have cooling channel welds with 3 and 2 mm, and it will be baked after Cu plating, which should reveal if there are any problems with the copper plating on the inside of the welded areas,
- CERN agrees that the welding works can continue and CERN will give an answer quickly after reception of the photo,

4. Coordinate systems & metrology

presentation by F. Gerigk: Slides in Indico

- the proposed coordinate system was agreed and the needed metrology data points were defined,
- **exception:** the origin of the coordinate system will be defined as the centre of the beam pipe opening on the outside of the cavity (instead of being the centre of the cavity with respect to the diameter),
- the outer surface of the beam pipe connection will be machined with a precision of 20-30 um, important are: parallelism to vertical axis and centre position of beam pipe, less important is the actual

diameter of the beam pipe,

5. Copper for fixed tuners

CERN has sent by accident ETP copper for the fixed tuners instead of OFE copper. BINP will make a brazing test with the delivered copper to see if it can be used for the tuners. If this turns out to be problematic, CERN will prepare a shipment of OFE copper.

6. Water manifolds & support jacks

- 3D drawings of the foreseen jacks have been transferred to BINP/VNIITF (EDMS 1083986),
- 2D example drawings of the water splitters (and their supports) which are foreseen for the PIMS were transferred and discussed (EDMS 1083973),
- for the CCDTL there will be two 4-fold splitters mounted on a central support next to the modules (pending a verification that the pressure drop for a 1/2 module is <4 bars),
- CERN will clarify the material choice for the pipes of the splitters: so far 316 L is mentioned on the drawings, which seems excessive,
- CERN will clarify the type of connectors used on the manifolds (most likely SERTO),

7. Water connections

- examples of water connections were brought by CERN,
- flexible rubber hoses are the preferred solution,
- CERN will verify the specs of the rubber type: radiation hardness, max. water pressure, and which type of tool is needed to fit the clamped connectors,
- 1st module will be mounted with test hoses & connectors at BINP. This will define the amount of hoses. CERN will then order radiation hard hoses and send them to BINP for the remaining modules. The hoses for the first module will be exchanged at CERN,
- CERN will provide information on industrial availability and on how to use the type of connector shown in Figure 1.
- can also be produced at BINP.

Figure 1: connection to flexible hoses.

8. Support frame

Presentation by D. Vavasov: Slides in Indico

The thickness of the steel profiles was increased to 11 mm, which reduced the maximum distortion of the longest frame from 0.1 mm to 0.05 mm. The value, which was requested at the 4th technical meeting. So far the stiffness of the cavities was not considered, which is likely to reduce the maximum distortion even further. However, so far an even distribution of the weight was assumed on all contact points between cavities and frame. Since it is far more likely that the ensemble of the cavities will rest on fewer points, further "worst case" simulations will done by VNIITF to ensure that forces at the coupling cell flanges remain below 112 MPa for tensile forces and below 170 MPa for bending forces. The worst case scenarioes should simulate conditions, which may arise during transport of the complete modules (e.g. uneven ground).

On the assumption that the present design is valid the planning is the following:

action	date
preliminary 3D drawings from VNIITF to CERN	September 2010
final version of 3D drawings and further simulation results	October 2010
launch of 2D construction drawings by CERN	October 2010
construction of 1st frame	ready for assembly in January 2011

9. Action list:

action	institute/person	status/result	completed
weldings of water channels			
provide photo of inside of 1st cavity, where the water channels were welded	VNIITF	done EDMS 1095235	2010-09-10
give feedback wether the observed traces can affect Cu plating	CERN	pending	
clarify the material choice for the pipes of the water splitters	CERN	done in the CERN drawings of the PIMS water splitter 316 L was given simply because this material is available as standard for these pipes, there is no problem using 304 L instead	
clarify the type of connectors used on the manifolds	CERN	done same welded SERTO fittings as on the cavities	2010-09-08
give material reference for used flexible water hoses (radiation hardness, etc)	CERN	done radiation hard EPDM pipe from Angst & Pfister, synthetic rubber inner lining, 1 reinforcement of one or two Kevlar inserts separated by one intermediate liner identical to the inner lining, 1 outer covering identical to the inner lining, EDMS 1097021	2010-09-08
give reference for water connector in Figure 1	CERN	pending	
clarify which type of tool is needed to clamp the water connectors	CERN	pending company: Uniflex GmbH, Photo 1, Photo 2	2010-09-08
support frame			
"worst case" simulations for the support frame	VNIITF	pending	
3D drawings of support frame to CERN	VNIITF	done EDMS 1097189 and EDMS 1111099 (restricted access)	2010-09-30
construction of support frame	CERN	pending	

-- FrankGerigk - 02-Sep-2010

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