

Informal Memo
20 May 2003

Subject: ARIES-CS Conference Call Minutes, 1 April 2003
To: ARIES Team

From: L. Waganer

Participants: (ANL) -
(Boeing) Waganer
(DOE) -
(FPA) -
(GA) Turnbull
(GT) -
(INL) Merrill
(LANL) -
(LBNL) -
(LLNL) -
(MIT) -
(MRC) -
(NRL) -
(NYU) Garabedian
(ORNL) Lyon
(PPPL) Brown, Ku, Neilson, Schmidt
(RPI) Steiner
(SNL) -
(UCB) -
(UCSD) Mau, Najmabadi, Raffray, Sze, Wang
(UW) El-Guebaly

Administrative

Les Waganer mentioned the Town Meeting on Liquid Wall Effects and the ARIES meeting in Livermore May 5-8. Les also asked participants of the May 7-8 ARIES-CS meeting to send him presentation titles and duration so he can assemble a preliminary agenda for distribution.

Les Waganer noted the minutes of the January ARIES meeting and that the February 11 and 25 conference calls are finalized and placed on the ARIES web site.

Status of ARIES-CS Technical Areas

Configuration Development for Compact Stellarator Reactors – Long-Poe Ku told the group that he observed a significant improvement (factors of 3 lower) in alpha losses in configurations similar to NCSX. In the January meeting, he reported alpha loss improvements up to 35% better, but these new configurations are even better. He wants to further explore the configuration space including 2, 3, and 4 field periods to improve the beta. He thinks the plasma current has an effect on the alpha loss. For a CS reactor with 1000 m³ plasma volume, the NCSX machine has alpha losses of around 20-30%, the configurations in January 2003 had alpha losses in the range of 15-20%, and now he is reporting losses in the range of 5-10%.

Long-Poe Ku wants to get the residual harmonics below 1%. In NCSX, the residual harmonics are around 2.5%. He is looking at partial orbits to determine loss orbits. At present, his survey is not complete as there are many local minima.

He is trying to organize his data to make sure his findings are well documented. Before recommending the attractive parameter space, he wants evaluate the effect for changing the plasma shape and increasing beta to approximately 5%. He would like to go beyond quasi-axisymmetric symmetry in the coming months. So far, he has only investigated fixed plasma boundaries with no coil definition.

At present, the Engineering Group should retain the present NCSX configuration. The two-field period case does look interesting as it has a high Q, but a smaller aspect ratio.

René Raffray mentioned that he asked Long-Poe Ku if it was possible to increase the coil size to utilize a common elliptical vacuum vessel. This was discussed, but the increased magnet size would adversely affect the ability to properly shape the plasma surface and local magnetic fields.

Two-Field Configuration Development – Paul Garabedian summarized his recent work on the 2-field period configuration. His case has an aspect ratio of 3.5. He sent the coil coordinates to Farrokh Najmabadi for evaluation and engineering assessment. Other machine specifics are minor radius = 2.6 m, R = 9 m, minimum coil midpoint to plasma surface = 1.4 m, and beta = 4% with good results for QAS. There are 12 coils that are only moderately twisted. The plasma surfaces are robust. Jim Lyon requested Paul's coil definition to analyze.

Paul thinks that the criteria for stability are too conservative, especially ballooning stability. Experimental data suggests a more liberal criterion.

Stellarator Reactor Optimization Code – Jim Lyon requested a set of representative, not necessarily an optimal, set to input into his code to verify proper operation and results. Long-Poe does not have a new set of coils, instead he suggested using the set provided to the Engineering Group. Another option is to use Paul's configuration of coils for the two field period option. T-K Mau wanted a POPCON plot to help with his ECH analysis.

T-K Mau said he is doing a scoping study for the ECH launcher. He is developing or modifying a ray-tracing code. He hopes to have some results for the May meeting.

Radial Build Analysis – Laila El-Guebaly is working on the FLiBe-FS first wall and blanket system with a thickness of 1.25 m (coil midpoint to plasma surface). The other option is the LiPb – SiC system that is similar to ARIES-AT design. She is also working to define a design option that is 20-cm thinner for the areas that might require a thinner shield-only region.

Maintenance Assessment - René Raffray mentioned that if an articulated maintenance boom is used, it is limited by the size and weight of the module and the distance it has to reach inside the reactor. A rail system, similar to ITER, would extend the capabilities, but the more complex geometry of a CS reactor might not accommodate a rail system.

Divertor Area – Don Steiner asked if the divertor area had been analyzed yet. He is concerned that we have not paid enough attention to the divertor region. We considered it, but not to any great extent. Laila thought it covers around 15% of the total FW area. It was mentioned that some configurations had natural divertor areas. Hutch Neilson said the NCSX has looked at it, but it has not been analyzed in detail yet.

Vacuum Vessel Placed Outside the Coils – Brad Merrill brought up the topic of locating the VV outside the coils to simplify the vacuum vessel. There is a concern about locating the coil coolant inside the vacuum boundary. This may pose a safety concern.

Coils – Jim Lyon asked about the coil current density versus the B_{\max} on the coils. It is recommended he contact Leslie Bromberg on this subject.