Informal Memo
11 March 2003

Subject: ARIES Conference Call Minutes, 11 February 2003
To: ARIES Team

From: L. Waganer

| Participants: | | |
|---|---|---|
| | (ANL) | - |
| | (Boeing) | Waganer |
| | (DOE) | - |
| | (FPA) | - |
| | (GA) | Petzoldt |
| | (GT) | Abdel-Khalik, Yoda |
| | (INEEL) | |
| | (LANL) | - |
| | (LBNL) | Debonnel |
| | (LLNL) | Abbott (Ryan), Meier |
| | (MIT) | Bromberg |
| | (MRC) | Rose, Welch |
| | (ORNL) | |
| | (NRL) | - |
| | (PPPL) | Brown, Schmidt |
| | (RPI) | |
| | (SNL) | - |
| | (UCSD) | Raffray, Tillack |
| | (UW) | El-Guebaly, Haynes |

**Administrative**
Les Waganer told the team that the next ARIES-IFE call will be March 20 and the next ARIES-CS will be February 25. The phone numbers have been previously distributed to the team.

The next meeting will be held at Livermore CA near the Lawrence Livermore Laboratory. Wayne Meier is arranging for the meeting location. René Raffray and Wayne Meier are arranging an ARIES Town Meeting on liquid protection for the target chamber. This meeting will commence on Monday, May 5 and continue through Tuesday, May 6, noon. Then the ARIES-IFE meeting will start in the afternoon of Tuesday, May 6 and continue until later that afternoon. The ARIES-CS meeting will begin on Wednesday morning, May 7 and continue until Thursday, May 8, noon. This should leave sufficient time to make airline connections. Announcements for speakers have been distributed beyond the ARIES team and are posted on the ARIES web site. The theme of the meeting will be an information exchange for recommended protection approaches and materials, modeling capabilities, and remaining key issues.

The ARIES team will be represented at the US/JA Reactor Workshop to be held in Tokyo 24-26 March 2003. Presently Farrokh Najmabadi, Said Abdel-Khalik, René Raffray, and Les Waganer will attend and present ARIES technical papers on both IFE and MFE subjects.

The draft ARIES minutes for the January 2003 meeting have been distributed and comments

have been incorporated. The final minutes will be distributed shortly.

Leslie Bromberg requested an FTP site be established. Mark Tillack replied that ARIES currently has an FTP site that efficiently and quickly transfers large files. Mark will inform the team of the site address and password.

## Status of IFE Technical Areas

### Target Materials, Injection, and Tracking

Ron Petzoldt addressed his action items regarding target costing at January's meeting. The action items he was asked to investigate were: a) validity of large cost reduction from using a central target fabrication facility (41 to 28 cents per target), b) appropriateness of large staffing levels (167 employees), and c) mitigating the effect of a single point failure.

The cost savings from scale up were probably overestimated in several areas: a) eliminating a 40% over-capacity factor was incorrect, b) using a 0.9 scale-up exponent (rather than 0.85) would be more correct, and c) maintaining a 25% laser equipment volume discount for buying 10 times as much gives a cost of 34 rather than 28 cents per target.

For the reference case staffing, the staffing component is 5 cents per injected target, or 12% of the total costs. Staff levels include 12 non-shift personnel (plant manager, 5 engineers and 6 clerical staff) plus 5 shifts of people to provide 24 h x 7 d coverage. There are 31 workers per shift, including 3 supervisors, 3 QA staff, 2 health physicists, 9 operators (1 in contactor area, 4 in hohlraum parts fabrication and assembly area, 2 in fill/layer area and 2 in target injection area) and 14 technicians (2 in contactor area, 6 in hohlraum parts fabrication and assembly area, 3 in fill/layer area and 3 in target injection area). It may be possible to reduce these personnel levels with increased automation. However, even reducing the staffing levels to 1/3 including increased costs of automation, the net savings will not likely exceed 2 cents per target.

Using parallel assembly lines for critical process steps could mitigate a single point of failure in the target assembly line. Both lines would normally run at half capacity. In case of a line failure, the alternate line could be quickly brought up to full capacity. Thus, there would be minimal interruption of targets to the power core.

### Chamber Engineering, Magnets, and Beam Propagation

Liquid Coolant Experiments - Said Abdel-Khalik reported on the suggestion by Les Waganer at the last meeting that rather than try to photographically or optically measure the aerosol generation near the liquid jet surface, a simple collection method might be used to gather aerosol mass samples over a longer time period. Said reported that the Georgia Tech group found some correlations in the literature for aerosol formation from cylindrical and slab jets that (in the absence of any type of flow conditioning, nozzle contraction or boundary layer cutting) suggested that as much as a few percent of the injected mass could become aerosol. Based upon these predictions, Georgia Tech assessed and experimentally conducted such a sample gathering technique that worked reasonably well on a rectangular slab water jet. In preliminary tests, they found that a significant amount of aerosol mass was collected near the surface and downstream of the orifice (up to several mg over minutes), but the amount collected was at least an order of magnitude less than that predicted by the correlations. This will have a very direct bearing on the amount of the aerosol in the chamber environment, as this is a continuous aerosol source term. They are planning to expand the experimental database with further tests with collection points in

varying downstream locations. Wayne Meier suggested that they also look at the aerosol distribution farther away from the slab jet surface, since drops within a few millimeters of the surface may not be as problematic as drops that migrate into the central pocket or farther into the openings in the crossed jets lattice.

Don Haynes asked about specific details of the test setup and test conditions. Said replied that the collection area was about 1 $cm^2$ and there was no clipping of the liquid jets. René Raffray asked if Per Peterson had done a similar experiment or collected such data with another experiment. Not to Said's or Christophe's knowledge.

Said continued that they have also been investigating the thin liquid film adhering to inverted surfaces of stainless steel and Lexan. They have expanded their experiments to handle downward-curving surfaces, as proposed in the Prometheus design. This configuration appears to give -better adhesion to the surface (*i.e.*, the film remains attached farther downstream of the injection point). The GT group plans next to quantify results for flat and curved surfaces with and without surface wetting.

Wayne Meier noted that LLNL is working on alternate approaches to eliminate the cross jets intended to protect the beamlines and target injection tubes. This effort is intended to achieve a simpler chamber design.

René Raffray said that he was working with Phil Sharpe to define the chamber aerosol requirements as established by the target and driver systems. He confided that the design parameter window is getting to be quite small (< 1 mTorr for neutral beam transport, < 100 mTorr for self pinch, and 1 Torr for assisted channel transport). [See discussion later regarding an increased pressure value for NBT.] René wondered if the size of the aerosol is important, but Dale Welch and David Rose noted that the beams are sensitive to the line-averaged mass density rather than particle size. René said they would try to obtain that information before the next meeting. It would be important to also know the average droplet size as a function of time.

It was asked if Phil had considered the chemical dynamics of the FLiBe during the rapid heating and condensation period. René said Phil had not. It was noted that there is a liquid spray on the sides of the HYLIFE chamber to aid and speed the condensation process.

Beamline Transport – David Rose mentioned that he is continuing to do the beam stability analysis for the neutral beam transport.

René pressed Dale about raising the allowable pressure limits for NBT beam propagation within the chamber. The reply was that perhaps the limit could be as high as 5 mTorr.