Interacting with the Technology at Fermilab

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The Fermilab Industrial Affiliates organization was initiated in 1980 to improve university-industrial research communications and facilitate the "spinoff" of state-of-the-art developments from the Laboratory. As one of the premier high-energy physics installations in the world, Fermilab is the off-campus research facility for some 70 U.S. universities. Our experience in cooperative development of complex technical components has encouraged us to seek a more systematic format for the exposure of our needs, problems, and our achievements to industry.

The Affiliates are a group of about 40 organizations with some interest in the research and development work under way at Fermilab. They include a wide spectrum of high-technology companies from the very large to vigorous new organizations. We hold a two-day annual meeting for company research directors and other senior personnel. This is a direct opportunity to see the work here at Fermilab. We encourage Affiliate staff visits to Fermilab and visits of our staff to Affiliate organizations. We also distribute Fermilab technical reports on a monthly basis to the Affiliates, based on their particular technical interests. Last, but not least, we know the Affiliates are interested in the Laboratory and that often means they are the first ones to know about interesting activities going on here.

These are some of the specific activities of the Industrial Affiliates. More generally, we are looking for concrete and effective ways to enhance collaboration of industrial research organizations, academic institutions, and national labora-

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tories. Of course, the interest of the Affiliates also serves to support the Laboratory in its dealings with the Department of Energy and the general public!

The annual membership fee for the Affiliates is $1000. If you are interested in membership, please get in contact with me, Dick Carrigan, (312) 840-3333, or Dr. Leon Lederman, (312) 840-3211, at Fermilab.

Technology at Fermilab

Now on the national agenda is an accelerator 20 times the size of the TEVATRON, the Superconducting Super Collider. Technically that project is a direct outgrowth of the TEVATRON at Fermilab. The TEVATRON is the world's first (and only) superconducting synchrotron. It is also the most powerful accelerator in the world. It operates like a Swiss clock. The TEVATRON is, by far, the largest superconducting project ever built.

How did the technology for the TEVATRON come about? The answer is several-fold: partly through a concerted program at Fermilab to develop a new magnet technology and partly through an informal program between U.S. industry and Fermilab to develop the superconducting-wire technology. Parenthetically, that relationship had its genesis more than a quarter of a century ago as a collaborative effort between the Westinghouse Research Laboratory and some particle physicists. This wire development has been technology transfer in the "good old-fashioned way," namely, a laboratory and vendors working together to develop an industrial-scale supply of superconducting wire. Today, we have a TEVATRON *and* a billion-dollar medical-imaging industry using superconducting wire. The success of that industry, with a quick start in the early Eighties, must have been due in part to the wire R&D for the TEVATRON in the Seventies. There is much valuable and relevant information and technology at Fermilab on dewars, sensors, oxygen deficiency hazards, quench protection, and cryogenic controls. Fermilab is where industrial-scale superconductivity is at!

Another technology at Fermilab is the award-winning Advanced Computer Program, or ACP for short. This is a good illustration of a technical development needed for special work here that has already gone on to become an industrial product marketed by an Affiliate, Omnibyte. Technology transfer has been an intrinsic part of the activity from the outset. Now further developments are

under way as the researchers set out to address the knotty problem of quantum chromodynamics, or QCD.

Another major effort has been the Loma Linda-Fermilab proton medical accelerator. The accelerator is now almost complete. This has been a so-called "work-for-others" project. From the outset it was envisioned that Loma Linda University Medical Center would find an industrial partner to commercialize the technology. That has now happened - the partner is an Affiliate, SAIC. Clearly, one can expect to see more technology spilling out of this unique hospital-industry-national laboratory collaboration. For example, there may be developments that could be important for the construction of compact synchrotron light sources for microchip lithography. By the way, an important member of the team fostering the transfer of this technology has been the State of Illinois. This was done through a grant from the Department of Commerce and Community Affairs. In effect, the Loma Linda project created about 100 man-years of employment in the state.

There are many other technologies that we have not discussed in detail at the meeting. These include such areas as software, controls, VME, and fast electronics. Some of these are summarized in the box on page 73. If you are interested, get in contact with us.

How to Interact with Fermilab

The best way for industry to interact with Fermilab is to join the Fermilab Industrial Affiliates. As noted earlier, the purpose of the organization is to set up a two-way street where we can work together. We're willing to try any good idea as long as it's legal. Remember, though, Fermilab is not an engineering experiment station. Our activities have to fit the Fermilab profile, and they can't be breaking somebody else's rice bowl.

The good old-fashioned way to interact mentioned earlier still holds. Successful bidders on Fermilab contracts can carry away a lot of very useful experience. Our sister laboratory, CERN, once estimated that most CERN contracts led to several times the business elsewhere.

Fermilab has now moved into a new area for us - licensing. We have much to learn. If there are technologies at Fermilab that you are interested in licens-

ing, let us know. You may have to teach us how to do it, but we are willing learners.

The Loma Linda project is an illustration of another way to interact. This is as a joint project or a work-for-others arrangement. From our standpoint these are fraught with problems. On the other hand, the Loma Linda project has been very successful as a technology transfer. Some of our Affiliates have also suggested some interesting ideas. A good arrangement is one where the Laboratory gets some direct benefit or service out of the collaboration, both parties contribute equally, and the company goes away with a technology they can pretty much call their own. But remember, DOE and our business people see this as trouble, trouble, trouble.

In some cases we have "modest" requests for technology. These are requests for individual circuit board layouts, items of software, or access to some special measuring equipment. Even these can get to be complicated, but we are trying to handle them as flexibly and quickly as possible on a direct cost recovery basis.

Finally, there are many possibilities for individual visits. Fermilab is about the best place in the world to visit. There are very few complications about passes or permission. It's certainly easier to park here than at most university campuses.

Summary

Clearly, there is lots of technology at Fermilab. This includes superconducting and cryogenic technology, advanced computer concepts, and accelerators to be used for medicine and software. There is a Chinese menu of other possibilities. Recent years have seen a real breakout in the tools available to transfer this technology. Universities Research Association will now own the Fermilab inventions, and Fermilab inventors will share in royalties. In addition, the Laboratory is developing a marketing arm and has retained legal counsel in the area of patents and licenses.

There are now many ways to access the Laboratory technology, including the Affiliates, the normal process of working on Fermilab procurements, licensing, joint projects such as Loma Linda, a willingness to support "modest" requests for specific items, and the obvious possibility of visits.

We are pleased with your interest in Fermilab. If you are an Affiliate, we are very gratified for your involvement with the Laboratory. If you are not an Affiliate, please join! We are not exclusive.

Some Fermilab Technologies

• Accelerators - Some of the most powerful and sophisticated accelerators in the world are in operation at Fermilab. A sparkling new development is the proton accelerator for medicine being built for Loma Linda Medical Center.

• Superconducting Magnets - Fermilab is the world center for superconducting magnets. This technology has relevance to many fields, including medical diagnostic imaging.

• Large-Scale Cryogenics - A substantial portion of the helium liquification facilities in the world are installed at Fermilab. Laboratory staff members have extensive experience in cryogenic control, compressor systems, simulation, and other areas of large-scale applied cryogenics.

• Radio-Frequency Systems - Fermilab has extensive experience in rf, including traveling-wave technology.

• Supercomputer Architecture - New, award-winning approaches to very-high-speed parallel computing have been developed at Fermilab.

• Computer codes - Fermilab has developed a vast array of computer codes including VAX system software, drivers for FASTBUS, VME, and CAMAC, and controls systems. Some of these will be available for licensing in the near future.

• Fast Electronic Data Handling - A number of control and data transmission systems using the FASTBUS, CAMAC, and VME standards are in operation.

• Particle Detectors - The heart of the Fermilab experimental program is detection and tracking of particles - protons, neutrons, photons, and charged ions. This has required the development of sophisticated scintillators, lead glass, wire chambers, and silicon detectors.

• Neutron Therapy - Fermilab's Neutron Therapy Facility, using the Linac beam, has treated more than 1400 patients - more than any other facility.

Appendices