TRIUMF

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SCIENTIFIC ACTIVITIES
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CANADA'S NATIONAL MESON FACILITY
OPERATED AS A JOINT VENTURE BY:

UNIVERSITY OF ALBERTA
SIMON FRASER UNIVERSITY
UNIVERSITY OF VICTORIA
UNIVERSITY OF BRITISH COLUMBIA

ASSOCIATE MEMBERS:

UNIVERSITY OF MANITOBA
UNIVERSITÉ DE MONTRÉAL
UNIVERSITY OF REGINA
UNIVERSITY OF TORONTO

UNDER A CONTRIBUTION FROM THE
NATIONAL RESEARCH COUNCIL OF CANADA

APRIL 1998

The contributions on individual experiments in this report are outlines intended to demonstrate the extent of scientific activity at TRIUMF during the past year. The outlines are not publications and often contain preliminary results not intended, or not yet ready, for publication. Material from these reports should not be reproduced or quoted without permission from the authors.

TECHNOLOGY TRANSFER DIVISION

INTRODUCTION

Technology Transfer is a TRIUMF division incorporating the Ventures Office and the Applied Technology group. This report reflects both aspects of the division.

TECHNOLOGY TRANSFER

The Technology Transfer Division's (TTD) mandate is the pursuit of all financially and technically viable opportunities for commercializing the technologies evolving from research at TRIUMF, in any appropriate manner that will enhance the Canadian economy. The provincial government provides funding to about $100,000 per annum for the Division.

The contribution agreement between NRC and TRIUMF emphasizes the requirement for TRIUMF to enhance its impact on the economies of western Canada. Specifically, there is an emphasis on providing benefits to small and medium-sized businesses in the western provinces, both through the TRIUMF purchasing practices, and through the transfer of technical knowledge and skills. NRC has commissioned both Western Economic Diversification (WED) and the Industrial Research Assistance Program (IRAP) to provide assistance in this effort.

As the responsible arm of TRIUMF in this regard, the objectives of the TTD are:

1. To transfer TRIUMF technical knowledge and skills to the Canadian economy, in particular the western Canadian economy.
2. To generate income for TRIUMF, for further research and development.

The crucial first step to commercializing new or innovative technologies from a research laboratory is to generate disclosures of such innovations. To this end, 25 potentially commercial disclosures have been documented this past year, and 5 of those have been funded by TRIUMF.

Also, in keeping with the mandate and objectives listed above, TRIUMF does have a number of technologies that are currently generating revenue or attracting the most interest. They are:

- isotope production
- various hardware developments for medical imaging using positron emission tomography
- radio frequency drying of agricultural products and lumber
- cyclotron production and developments
- proton therapy for eye melanomas
- nuclear imaging techniques for detecting concealed contraband
- 3D imaging
- environmental protection using cryogenics to eliminate smoke stack emissions
- radiation testing

In keeping with the focus on western Canadian small to medium-sized businesses, the TTD has, with the help of WED, organized 5 industry supplier shows in each of the western provinces this past year. The purpose of these shows was to acquaint industry representatives with TRIUMF's activities, to present procurement opportunities, and to establish contacts.

Our contract administrator is also ensuring that there is a conscious effort made to attract bids from as many eligible western Canadian companies as is reasonably possible. The representatives at Western Diversification in Vancouver assist TRIUMF with the dissemination, throughout western Canada, of information concerning TRIUMF's activities and purchasing requirements.

A broad spectrum of technologies evolves at TRIUMF, each with its own window of opportunity for commercialization. Any technology advance not properly exploited can become stale, and surpassed either technically or economically in the marketplace. Our role at TRIUMF must be the timely identification of the technologies followed by appropriate commercialization that optimizes the opportunity.

TRIUMF's strength lies in the unique aspects of the facilities, combined with the scientific excellence of the staff and the research conducted here. Patent protection can be important in identifying a novel technology, but at this level of scientific discovery it cannot be relied on as a long-term shield from competitive alternatives.

The TTD has established a network of contacts with many commercialization offices and facilities throughout North America and the world, and constantly utilizes those contacts in its own activities.

New technology such as that emanating from TRIUMF is, by definition, a high-risk venture. Although projects may appear to have promising potential, from experience it can be predicted that not all of them will actually fulfil expectations. The TTD has always taken a conservative approach in projecting current opportunities into future commercial activities.

APPLIED TECHNOLOGY GROUP

500 MeV isotope production facility

During this year the 500 MeV irradiation facility received 249 mAh. Eight Mo targets were irradiated to produce ^{82}Sr/^{82}Rb for MDS Nordion. In collaboration with LAMPF, we also irradiated two ZnO targets to produce ^{67}Cu that is being used in a therapeutic clinical trial program. These targets were shipped to LAMPF for chemical processing.

CP42 facility

The total beam delivery for this year was 0.66 Ah. The weekly beam delivery graph is shown in Fig. 133, the (quarterly) time evolution of the beam delivery is displayed in Fig. 134, and the downtime and maintenance statistics are analyzed in Fig. 135 and compared with the TR30.

The rf dees developed a small water leak and were removed for repair. At this time we also added rf blockers on the dee stems and improved the water distribution manifold at the back of the dee structure.

TR30 facility

The total beam delivery for this year was 4.49 Ah. The weekly beam delivery graph is shown in Fig. 136, the (quarterly) time evolution of the beam delivery is displayed in Fig. 134, and the downtime and maintenance statistics are analyzed in Fig. 135 and compared with the CP42.

A systematic program was undertaken to evaluate the maximum beam current during *routine* isotope production using the newest solid targetry systems developed by the ATG at TRIUMF. Taking into account variations in electroplating quality, water cooling, beam tuning, etc. required a relatively large sample of irradiations. The results indicated that beam currents of up to 350 μA at 29 MeV were possible for Tl-203, Zn-68 and In-111 targets. Work continues on targets electroplated with Ni-58. By the end of 1997 our operating licence had been amended to reflect these increases. Testing of larger surface area targets (that are predicted to run at twice these beam currents) was also performed with beam currents up to 820 μA without any sign of damage.

ATG research projects

An encapsulated target system (for irradiating powders, foils, etc.) had been designed to run using a similar transfer system to that presently employed by

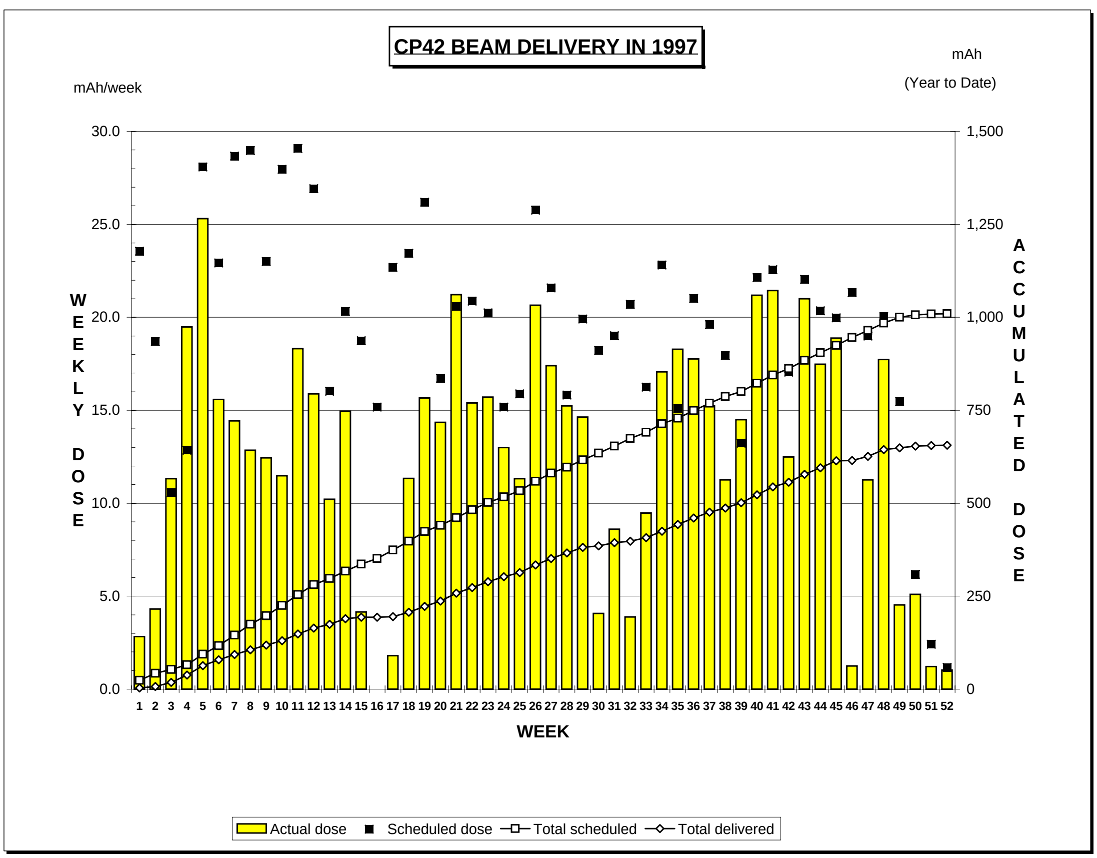

Fig. 133. Weekly beam delivery for the CP42.

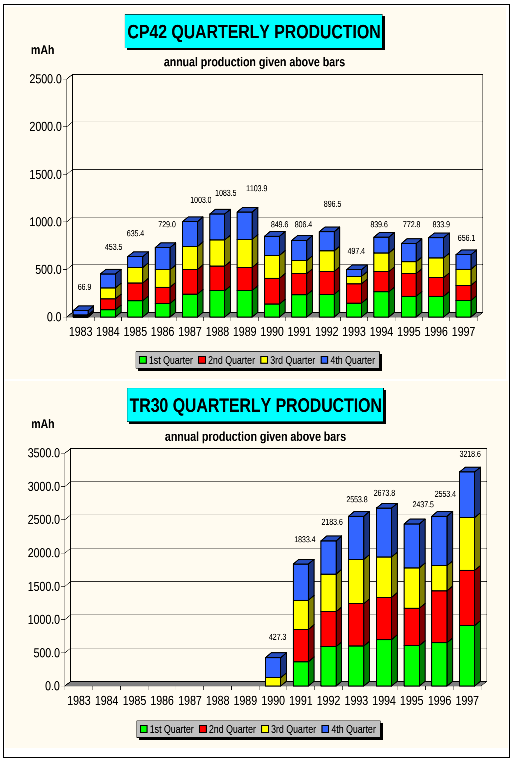

Fig. 134. Quarterly time evolution of the beam delivery for the CP42 (top) and TR30 (bottom).

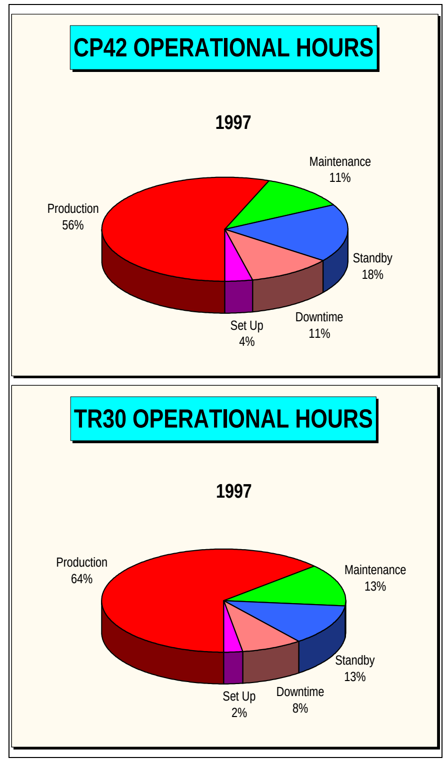

Fig. 135. Breakdown of downtime and maintenance for the CP42 (top) and TR30 (bottom) during operational hours.

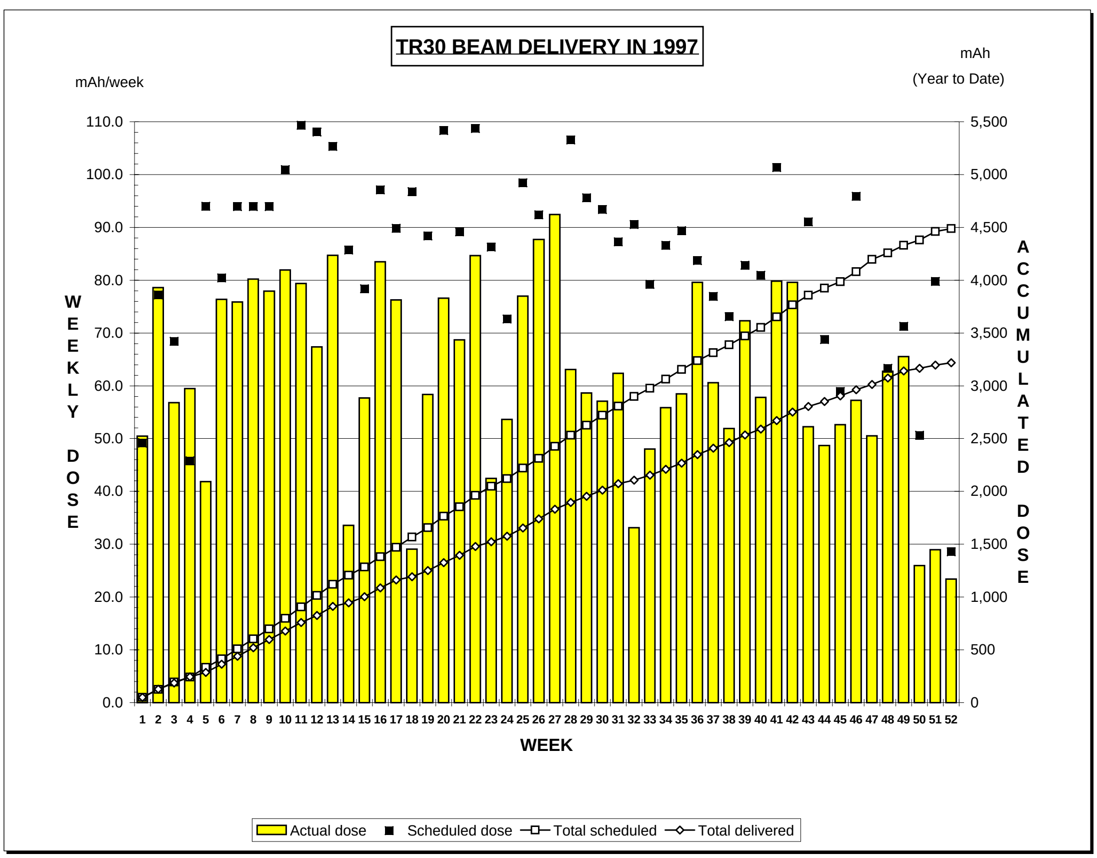

Fig. 136. Weekly beam delivery for the TR30.

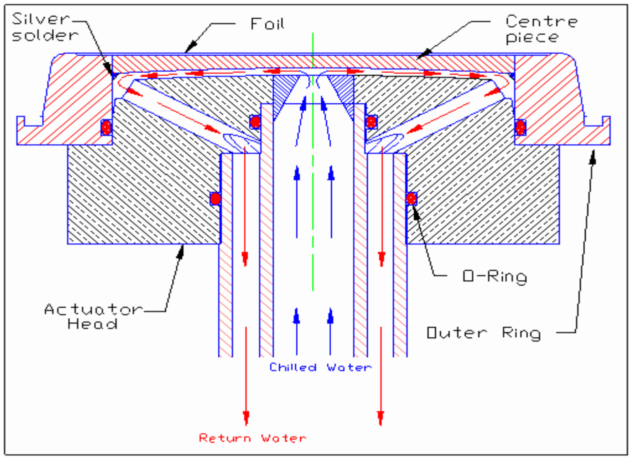

Fig. 137. Prototype encapsulated target for isotope production.

the solid target stations. Figure 137 shows a prototype of this encapsulated target (which also incorporates many of the features of its solid target counterpart but differs in that the target is a horizontally oriented disk that requires the beam to be bent down vertically at about 20°) that was built and tested on a conventional solid target station. The effect of beam currents of up to 150 μA at 29 MeV were monitored using implanted and electroplated thermocouples on the target surface. The measurements, indicating only a 30–50°C increase in temperature, revealed that the designed axial water cooling system is indeed very efficient.

In anticipation of the potential for even higher beam requirements in the future work is under way to develop an improved ion source. Stronger containment magnets for the plasma, the use of a minute partial pressure of cesium vapour in the plasma, and the use of a LaB_6 filament are all being investigated on the centre region model before being transferred to the TR30 for routine production. A prototype Cs oven and injection system was tested and results indicate that a significant increase in the output H^- current is possible. We are also investigating the possibility of optimizing the injection line components, particularly the location of the buncher, to enhance the ease of operating higher beam currents on a routine basis.

During 1997 ATG members were actively involved with organizing workshops and conferences. These activities included three invited talks and four other presentations, chairing sessions at four conferences and being on the advisory committees of four conferences. Two co-op and two graduate students were supervised resulting in four technical reports.

RADIOISOTOPE PROCESSING (MDS NORDION)

During 1997, MDS Nordion shipped large quantities of short-lived medical isotopes produced using the TR30 and CP42 cyclotrons. The main contributor to sales was thallium-201, used around the world for cardiac studies.

MDS Nordion passed a U.S. Food and Drug Administration audit, which confirmed Nordion's capability to produce radiopharmaceutical products in compliance with strict U.S. regulatory requirements. This supports Nordion's program to commercialize a number of radiopharmaceutical products using Iodine-123 – including a proprietary heart imaging agent and a brain imaging agent – under contract with a U.S. company.

The TRIUMF cyclotron was used to produce large-scale batches of strontium-82 whose daughter product, rubidium-82, is used in PET studies. As well, work continued on the development of new isotopes and applications in cooperation with TRIUMF.

The TRIUMF-led project to upgrade the capacity of Nordion's TR30 cyclotron was officially completed during the year. The Atomic Energy Control Board approved a licence amendment to allow sustained high current irradiations. The TR30 is now the most powerful isotope production cyclotron in the world.