CMD 19-H2.1C

File / dossier : 6.01.07 Date: 2019-05-08 5899354 Edocs:

Supplementary Information

Renseignements supplémentaires

Written submission from **Best Theratronics Limited** Mémoire de **Best Theratronics Limited**

In the Matter of the

À l'égard de

Best Theratronics Limited

Best Theratronics Limited

Application for the renewal of the Class IB **Nuclear Substance Processing Facility Operating Licence**

Demande de renouvellement du permis d'exploitation d'une installation de traitement de substances nucléaires de catégorie IB

Commission Public Hearing

Audience publique de la Commission

May 16, 2019

Le 16 mai 2019



This page was intentionally left blank

Cette page a été intentionnellement laissée en blanc

Best Theratronics

Class 1B License Renewal
Class II Facility & NSRD License Applications
CMD 19-H2.1C



The Future of Healthcare Delivery in the 21st Century – Contributions of TeamBest Companies & Best Cure Foundation





Best medical international

TeamBest Theratronics ASIA

Best Cyclotron Systems

Best Particle Therapy

Best Theratronics

Best medical canada

Best medical italy







Best nomos

Best Dosimetry Services





Best ABT Molecular Imaging









Your Total Solutions™ Provider!



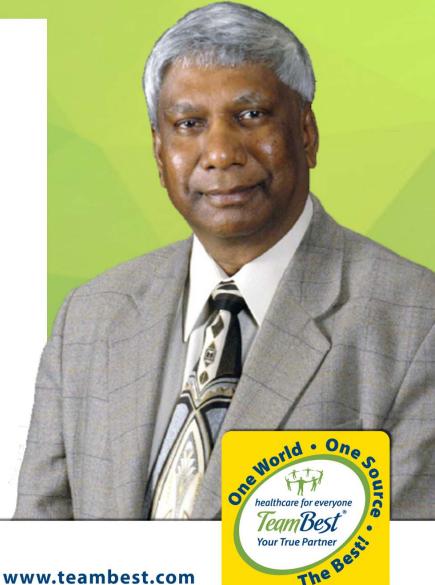
About Krishnan Suthanthiran

President TeamBest Companies & Founder of Best Cure Foundation

A healthy person has many wishes, but the sick person has only one. Health is wealth.

- Indian Proverb -





About Krishnan Suthanthiran

President TeamBest Companies & Founder of Best Cure Foundation

Life is a gift from our parents. We are born to live, and live to enjoy and cherish our gift. We can look at every obstacle as an opportunity or every opportunity as an obstacle. Who we are, what we are, and where we are, have a lot to do with the choices we have made and the ones we did not. Our career and service to the community are the outcome of what we do with the gift.

- Krishnan Suthanthiran -



world . One

ABOUT KRISHNAN SUTHANTHIRAN

Krishnan Suthanthiran immigrated to Canada from India in September 1969 after graduating with a Bachelor's Degree in Mechanical Engineering from University of Madras, India, to pursue his Master's Degree in Mechanical Engineering at Carleton University, Ottawa, Ontario, Canada. He arrived with a total of 400 Canadian Dollars. Subsequently, he received a National Research Council of Canada Research Assistantship, and graduated with a Master's Degree in 1971. He moved to the United States in 1972 and worked as an Engineer Physicist at Howard University Hospital in Washington, DC, USA until 1978.



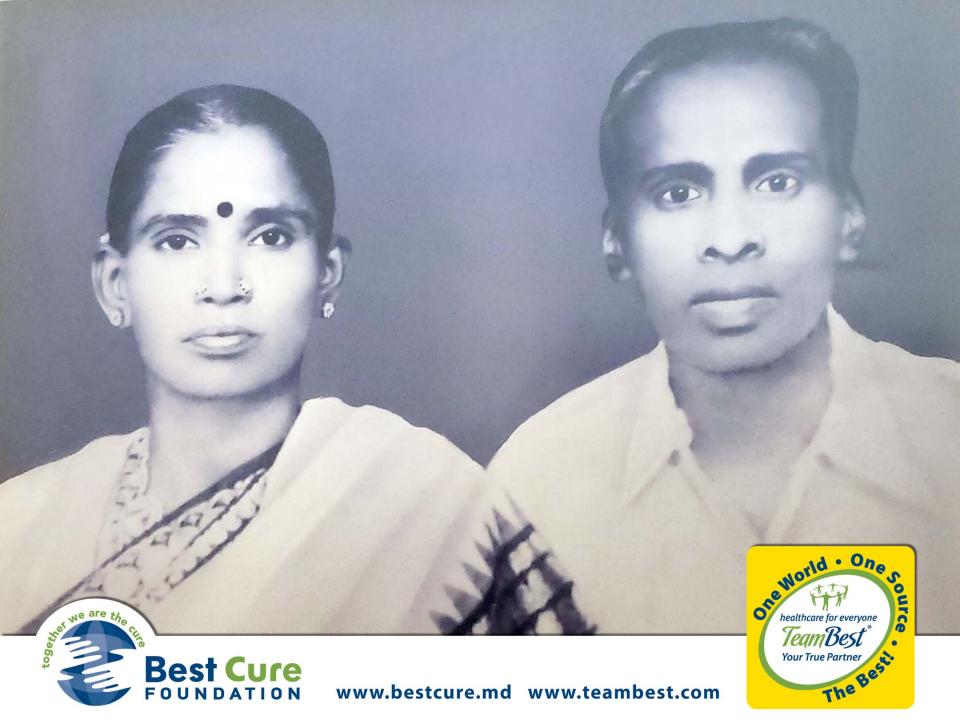
World . One

ABOUT KRISHNAN SUTHANTHIRAN (cont.)

Having lost his father to cancer while he was an undergraduate student in engineering, he has dedicated his career to cancer prevention, early detection and effective treatment for the Total Cure. He has founded and invested globally many millions of USD in medical, real estate, construction, entertainment, and energy companies. He founded and currently is supporting a few non-profit charitable foundations to promote quality education and healthcare and making them affordable and accessible. He has contributed substantially to setting up endowed chair and endowments for scholarships. Also, he has provided significant funding to support medical research and treatment by partnering with academic centers, national labs, and hospitals globally.



World . One

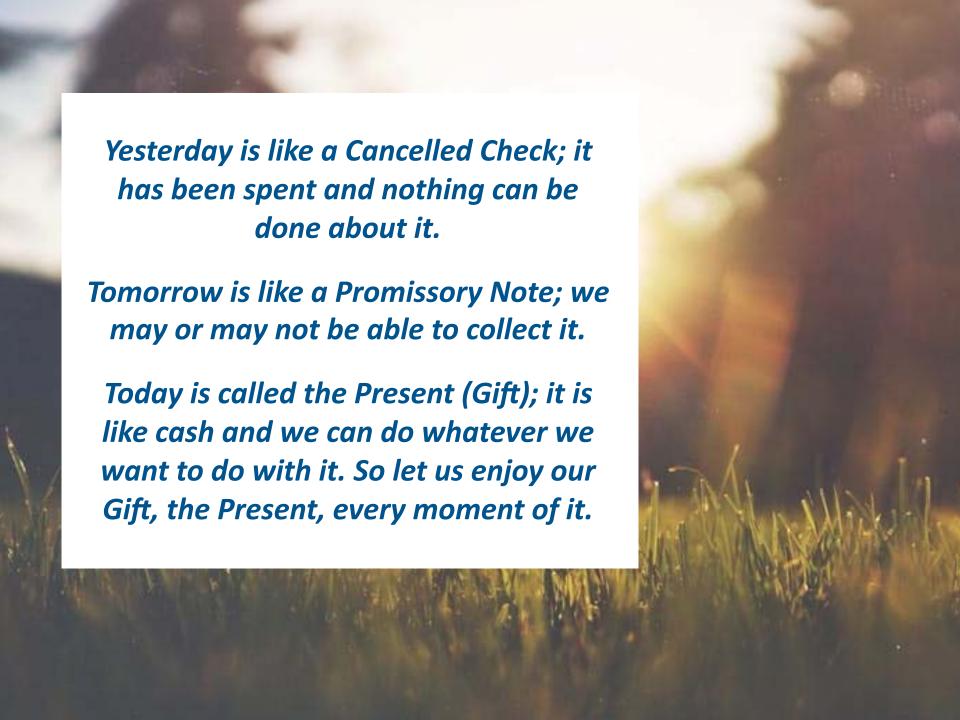




Krishnan Suthanthiran has established a division under BCF called "3E - Education, Empowerment and Equality" to promote the development and advancement of women. It is his belief that every man and woman was given birth to, nursed, and nourished by women, and therefore, they share a greater responsibility in juggling career and family, in raising children and caring for the home. In memory of his mother, Krish is proud to support women around the world in pursuing their goals through the 3E organization.







Best Cure Foundation's aim is to:

- Reduce the cost of healthcare worldwide by 30 percent or more
- Launch the Best Cure Total Health™ Program
- Increase transparency through Best Cure Proactive Healthcare™





Best Cure Foundation's aim is to:

Establish:

- Express/mobile clinics and medical centers as non-profit, private, non-governmental organizations that are self sustaining
- Best Cure U.S. Health Corps
- Best Cure International Health Corps
- Best Cure Global Institute
- Best Cure Global Standard of Care
- Best Cure Global Purchasing Organization
- Best Cure Global Insurance





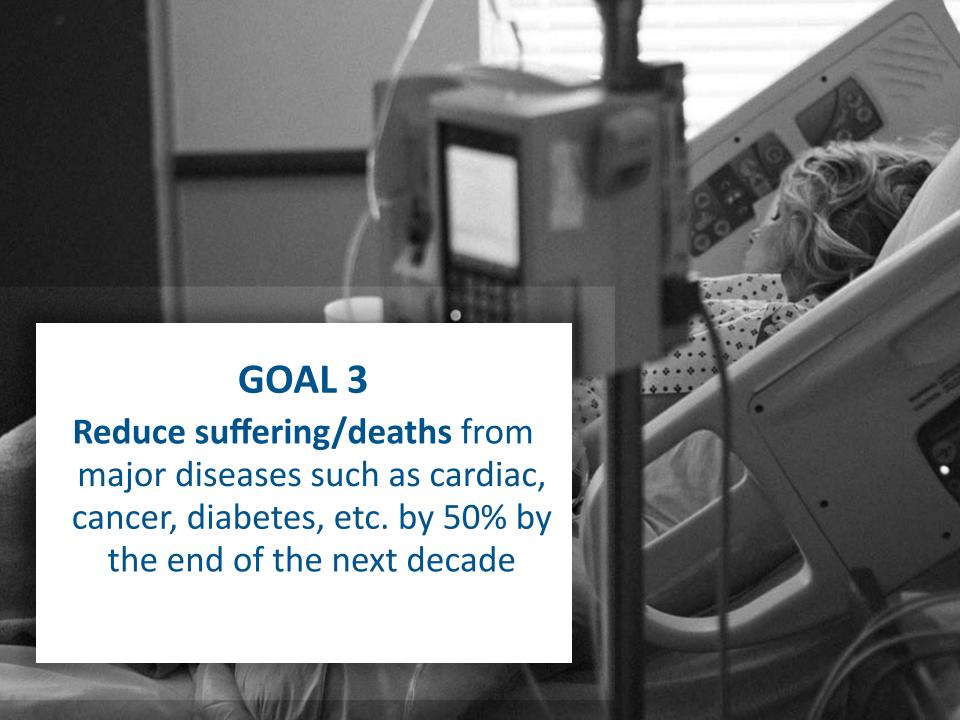
BEST CURE FOUNDATION's GOALS













Global War on Cancer

Launched by Best Cure Foundation & TeamBest Companies

While there have been many significant improvements and advancements in medical technologies, many patients around the world do not receive timely interventions or the right care. Mr. Suthanthiran firmly believes more should be done. In 2007, he formed the Best Cure Foundation to work with TeamBest companies, and other leading-edge companies and experts, to establish a Hub-and-Spoke model of healthcare delivery systems to overcome these shortcomings. Best Cure Foundation's goal is to launch a "Global War on Cancer" that includes express and mobile clinics linked to general and super-specialty medical centers worldwide.



iorld . On

Global War on Cancer

Launched by Best Cure Foundation and TeamBest Companies

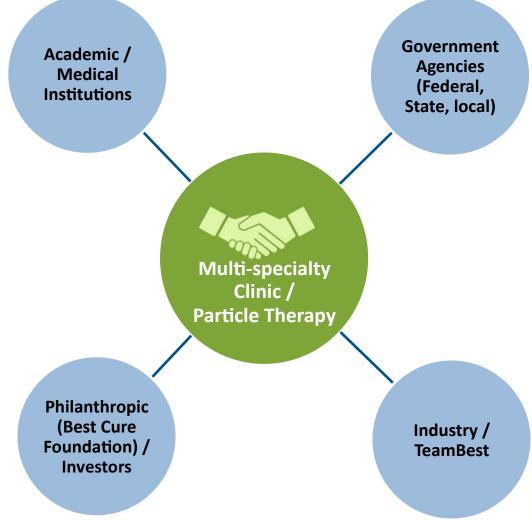
Mr. Suthanthiran has interacted with those in the private sector and government agencies, in more than 20 countries over the last few years in Asia, South America, the Middle East, and North America. In that time, he has stated, "It is clear that there is a groundswell of support for a better, affordable, and accessible healthcare delivery system globally."

He has established and acquired a number of medical companies globally, in order to collect many of the technologies needed to establish a Proactive Healthcare Delivery System, focused on transparency of clinical benefits, outcome, and cost using a Total Health Approach – Prevention, Early Detection,





Public/Private Partnership Funding Model









Emergency Area and Operating Room





Physicians Scrub Room and ICU





Lobby and Lab





Best TheratronicsExternal Beam Therapy & Accessories





GammaBéam)_m saving lives

Evolution of Radiation Therapy – Cobalt-60

Cobalt 60 widely used for conventional RT in most of the world.

But..

Has lacked the required technical R & D to facilitate IMRT/IGRT...

UNTIL NOW



GammaBeam™ 300 Equinox™ External Beam Therapy System



The GammaBeam 300
Equinox's advanced
design provides freedom
in treatment planning and
can interface to all of the
major record and verify
systems to allow for rapid
treatment parameter
loading, treatment set up
verification, and the
recording of the delivery.



GammaBeam[™] 100-80 External Beam Therapy System



The GammaBeam[™] 100-80 is a highly practical model of the GammaBeam family of External Beam Therapy System (EBTS). Convenience and safety, combined with simplicity of design, make it easy to use and easy to maintain.



Motorized and Manual Multi-Leaf Collimators



Multi-Leaf Collimators now available as an optional accessory for the Equinox and GammaBeam 100-80 product line, providing 3D Conformal Radiation Therapy (3D CRT) and Intensity

Modulated Radiation Therapy (IMRT) capability.

GammaBeam[™] 500 Total Body Irradiator



The Total Body Irradiator
GammaBeam 500 is a
teletherapy unit designed to
produce a large fixed rectangular
radiation field at an extended
source-to-skin distance in order
to deliver total body irradiation.
Used in preparation of bone
marrow transplantation.



nomosSTAT™ Serial Tomotherapy



nomosSTAT[™] serial tomotherapy delivery technology fires pencil beams from a continuous 340 degree arc around the patient, creating a highly conformal dose distribution.



GammaBeam[™] 200 Research Irradiator



The GammaBeam 200 (GB200) is among the most versatile research irradiators available today. Suited to a broad spectrum of applications including secondary standards dosimetry, sterile insect programs, and medical or veterinary research, the unit provides your lab with a powerful tool.

Blood Irradiation - Raycell[®] Mk2



Treatment of Graft-Versus-Host Disease (TA-GVHD) is almost always ineffective, and therefore management must focus on prevention by minimizing the risk of developing the condition. Blood irradiation using the Raycell® Mk2 uses two opposing x-ray tubes to deliver superior uniform dose.



Blood Irradiation – GammaCell® 1000/3000

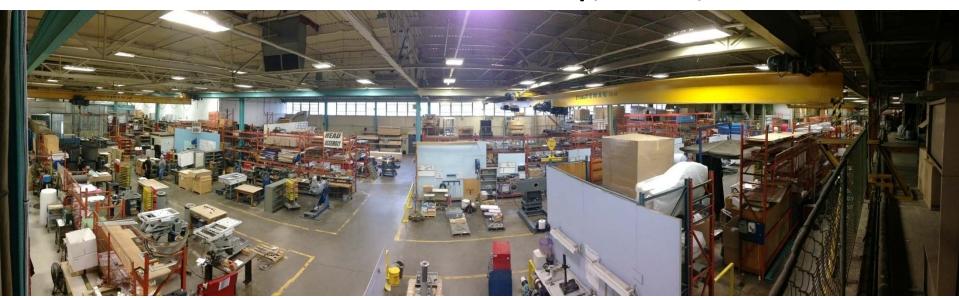


Blood irradiation using Caesium¹³⁷ available with the **Gammacell® 1000/3000** for superior performance and unparalleled dose uniformity





Best Theratronics Ltd Machine Shop, Ottawa, Canada



Best Theratronics Ltd Assembly Hall

Best ABT Molecular Imaging Dose On Demand™ BG-75 Biomarker Generator



Best ABT Press Release • November 12, 2018

TeamBest Companies enters agreement to acquire ABT Molecular Imaging, Inc. and announces creation of Best ABT, Inc.

Best Medical International, Inc. (BMI) and Best Cyclotron Systems (BCS) both part of the TeamBest group of companies, are pleased to announce the creation of Best ABT, Inc. Best ABT, Inc. has entered into an agreement to acquire ABT Molecular Imaging, Inc. (ABT), a Knoxville, TN based cyclotron manufacturing company.

The TeamBest group of companies, founded by Krishnan Suthanthiran, is headquartered in Springfield, Virginia, USA, and manufactures a variety of quality products for the radiation therapy and diagnostic community. BCS currently offers a wide array of cyclotrons ranging from 15 MeV to 70 MeV. A fully-functioning Best 70 MeV cyclotron has been successfully installed in Legnaro, Italy. BCS is currently installing several other cyclotrons in various countries worldwide.

Best ABT Press Release • Continued

Best ABT, Inc. will be a valuable addition to the TeamBest cyclotron portfolio that will allow TeamBest to deliver quality oncology diagnosis and care to a large group of currently underserved patients worldwide. The acquisition of ABT will bring a wealth of experience in smaller cyclotron technology, as well as in automated chemistry to TeamBest.

The cyclotron manufactured by ABT, the BG-75 Biomarker Generator (BG-75 System) is smaller and easier to install and operate than most conventional systems. The BG-75 integrates a compact cyclotron with micro-chemistry and automated quality control system, to provide on-demand F-18 FDG production in one seamless solution ("Dose-On-Demand") to support the diagnostic community. With more than 25 BG-75 Systems sold worldwide, Best ABT, Inc. will allow the TeamBest group of companies to expand its global reach into more diverse markets than ever before.

Best ABT Press Release • Continued

With this acquisition, TeamBest is taking another step in delivering on its promise to deliver "healthcare for everyone". Together with Best Cure Foundation (BCF), the TeamBest group of companies will set up a hub-and-spoke model healthcare delivery system, linked to General, as well as Super-Specialty Medical Centers, availing themselves of all of TeamBest's new and advanced technologies worldwide.

The BG-75 Biomarker Generator is a revolutionary development in radiopharmaceutical production that delivers a single or batch dose of ¹⁸F-FDG, and additional advanced ¹⁸F biomarkers, "on demand". The system provides integration of all components needed to produce and qualify PET biomarkers into a single, self-contained system that occupies a fraction of the space required by conventional solutions, simplifying the implementation of PET.







The BG-75 Biomarker Generator integrates a compact mini-cyclotron, kit based micro-chemistry, and automated quality control, simplifying in-house production of ¹⁸F-FDG and advanced biomarkers.

- Push button graphic interface
- Kit based chemistry
- Single or batch dose production
- Final dose delivery to syringe or vial (option)
- Automated quality control testing
- Integrated cyclotron & chemistry self-shielding
- Complete production lab in a 30²m area



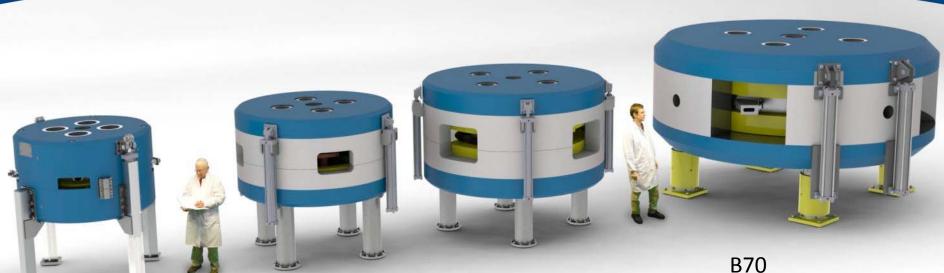




Best Cyclotron Systems For Research & Radioisotope Production



TeamBest® Cyclotron Designs



B15 PET

15 MeV

400 uA

Targets

Radiochem

B25

20-25 MeV

400 uA

Targets

Radiochem

B35

15-35 MeV

1000 uA

Targets

Radiochem

35-70 MeV

1000 uA

Targets

Radiochem



Best Cyclotron Systems

Cyclotron	Energy (MeV)	Isotopes Produced		
Best 15	15	¹⁸ F, ^{99m} Tc, ¹¹ C, ¹³ N, ¹⁵ O, ⁶⁴ Cu, ⁶⁷ Ga, ¹²⁴ I, ¹⁰³ Pd		
Best 20u/25	20, 25–15	Best 15 + ¹²³ l, ¹¹¹ In, ⁶⁸ Ge/ ⁶⁸ Ga Best 15 + ¹²³ l, ¹¹¹ In, ⁶⁸ Ge/ ⁶⁸ Ga		
Best 30u (Upgradeable)	30			
Best 35	35–15	Greater production of Best 15, 20u/25 isotopes plus 201TI, 81Rb/81Kr		
Best 70	70–35	⁸² Sr/ ⁸² Rb, ¹²³ I, ⁶⁷ Cu, ⁸¹ Kr + research		

Best Cyclotron Systems provides 15/20/25/30/35/70 MeV Proton Cyclotrons as well as 35 & 70 MeV Multi-Particle (Alpha, Deuteron & Proton) Cyclotrons

- Currents from 100uA to 1000uA (or higher) depending on the particle beam are available on all BCS cyclotrons
- Best 20u to 25 and 30u to 35 are fully upgradeable on site



Best Cyclotron Systems



Assembly of a
Best 35 MeV
Cyclotron
at Best
Theratronics
facility, Ottawa,
Ontario, CA



Best Cyclotron Systems



Installation of Best 70 MeV Cyclotron at Italian National Laboratories (INFN), Legnaro, IT



Installation of 70MeV Cyclotron May 2015 - Legnaro, Padova, Italy



Installation of 70MeV Cyclotron May 2015 - Legnaro, Padova, Italy



Inauguration of 70 MeV Cyclotron at INFN December 2016 - Legnaro, Padova, Italy



Front Page News in Padova, Italy



70 MeV Cyclotron at INFN



Best Particle Therapy ion Rapid Cycling Medical Synchrotron (iRCMS)



Collaboration with the Best in the World

In 2009, Best Medical International (BMI) and Brookhaven National Laboratory (BNL) signed an agreement called CRADA (Cooperative Research And Development Agreement)

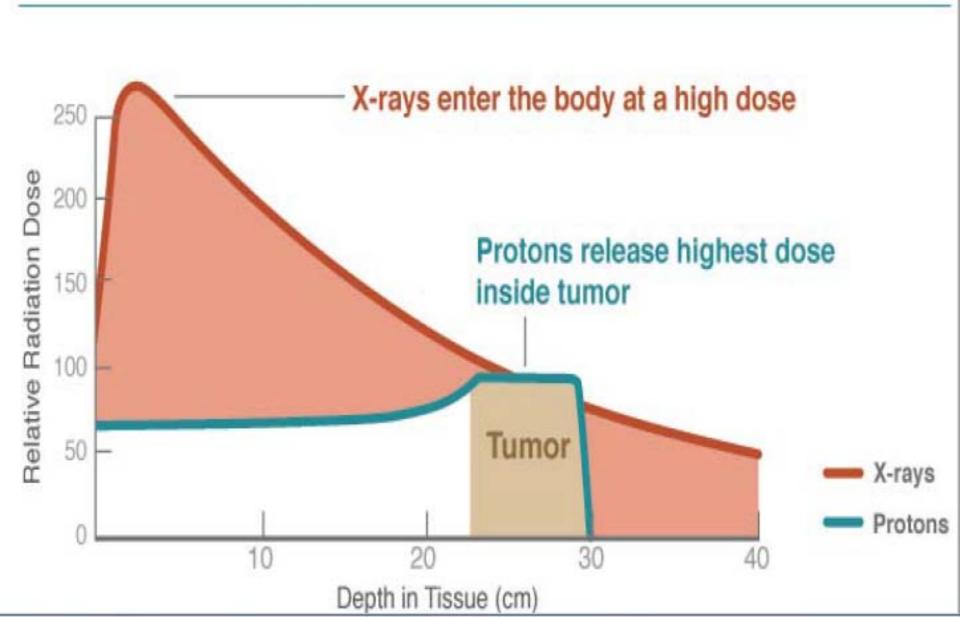
The mandate was to develop an ion Rapid Cycling Medical Synchrotron (iRCMS)



BNL (USA) Particle Accelerators 0.75 MeV to 250 GeV

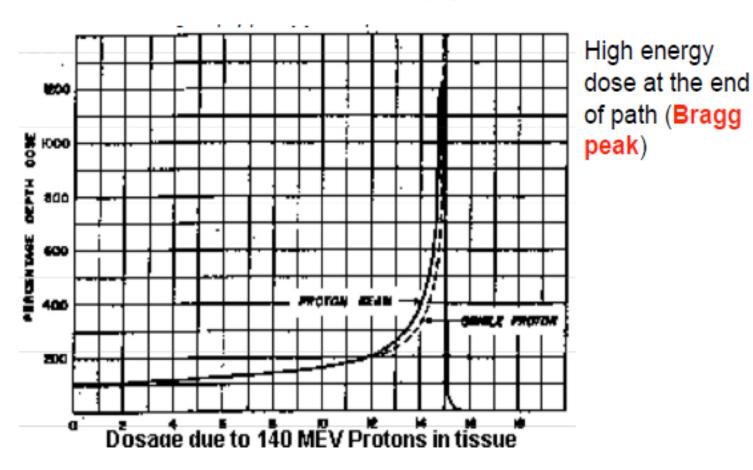


Proton therapy precisely targets tumors, reducing the radiation dose to healthy tissue compared with X-rays¹



1946 "Radiological Use of Fast Protons" and discovery of the Brag Peak

ROBERT R. WILSON Research Laboratory of Physics, Harvard University



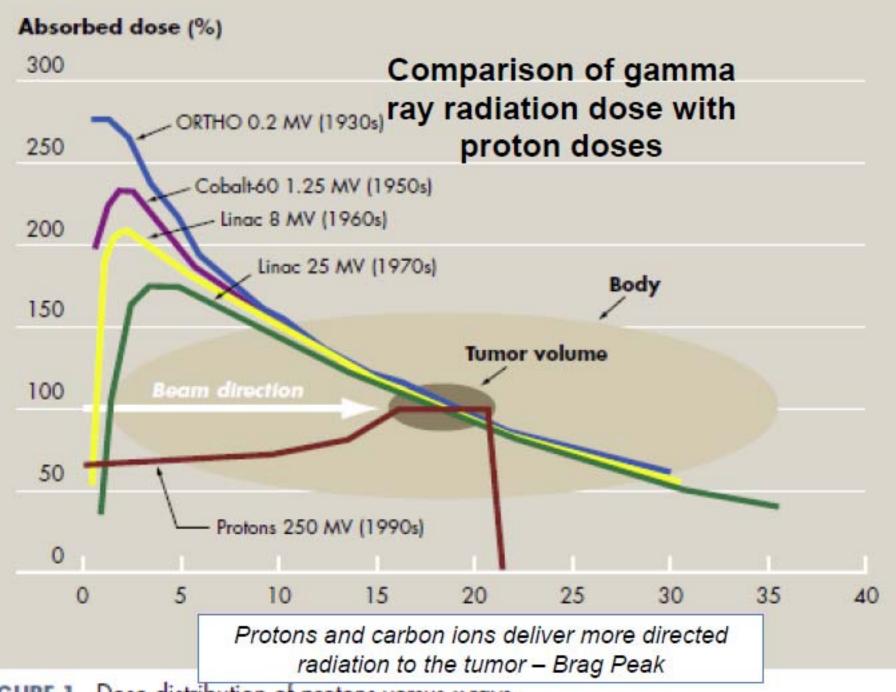
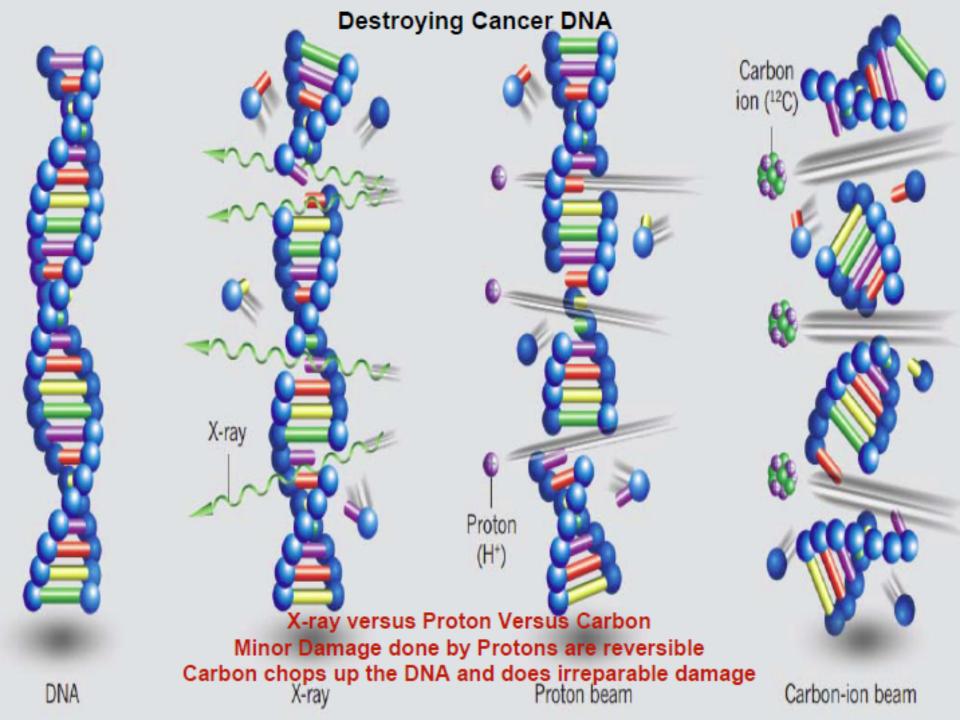
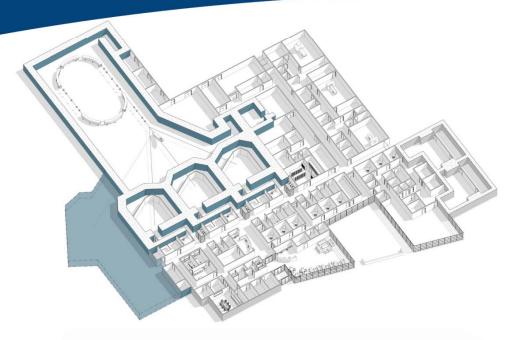
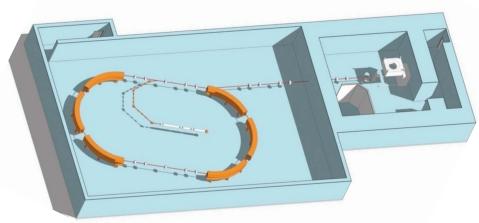


FIGURE 1 Dose distribution of protons versus x-rays.



Expandable from Single-Room to Multi-Room

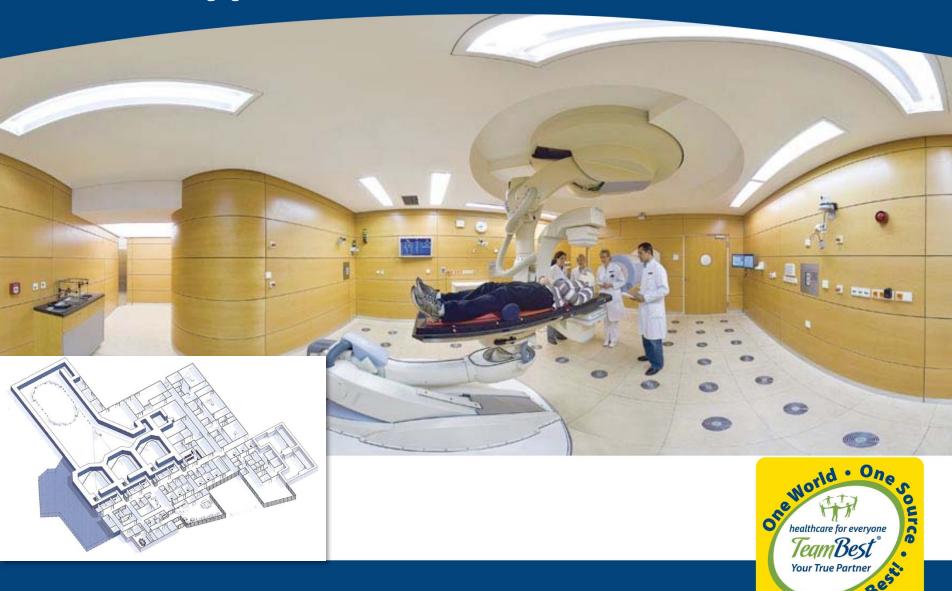




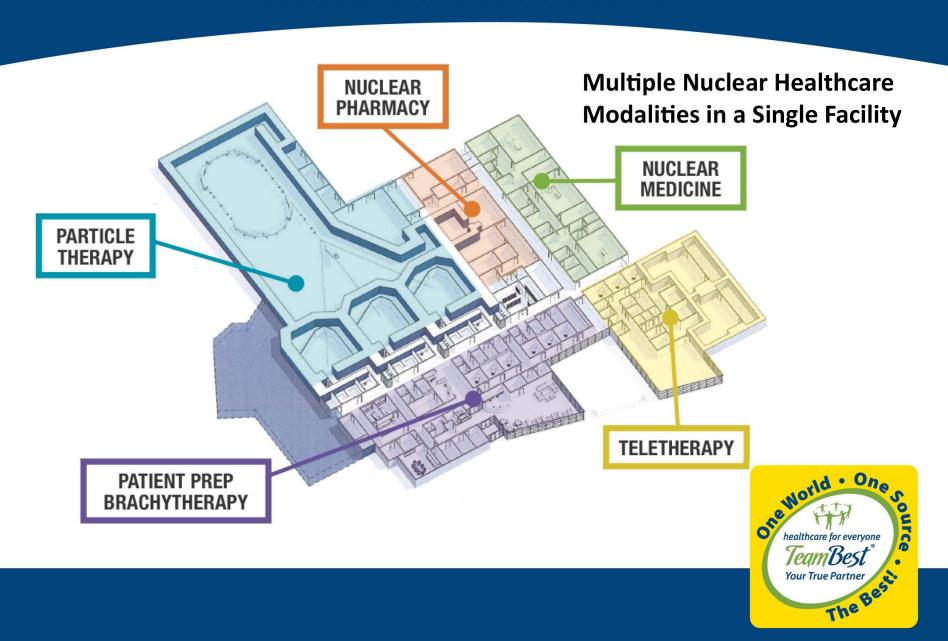
400 MeV Rapid Cycling Medical Synchrotron for Proton-to-Carbon Heavy Ion Therapy:

- Intrinsically small beams facilitating beam delivery with precision
- Small beam sizes small magnets,
 light gantries smaller footprint
- Highly efficient single turn extraction
- Efficient extraction less shielding
- Flexibility heavy ion beam therapy (protons and/or carbon), beam delivery modalities

Typical Treatment Rooms



Multi-Room Solution





Single-Room Solution

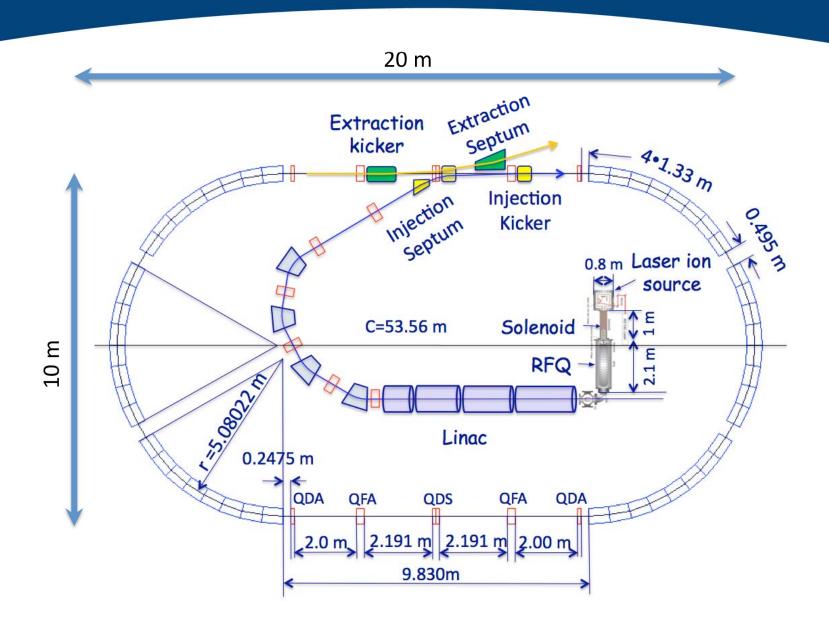




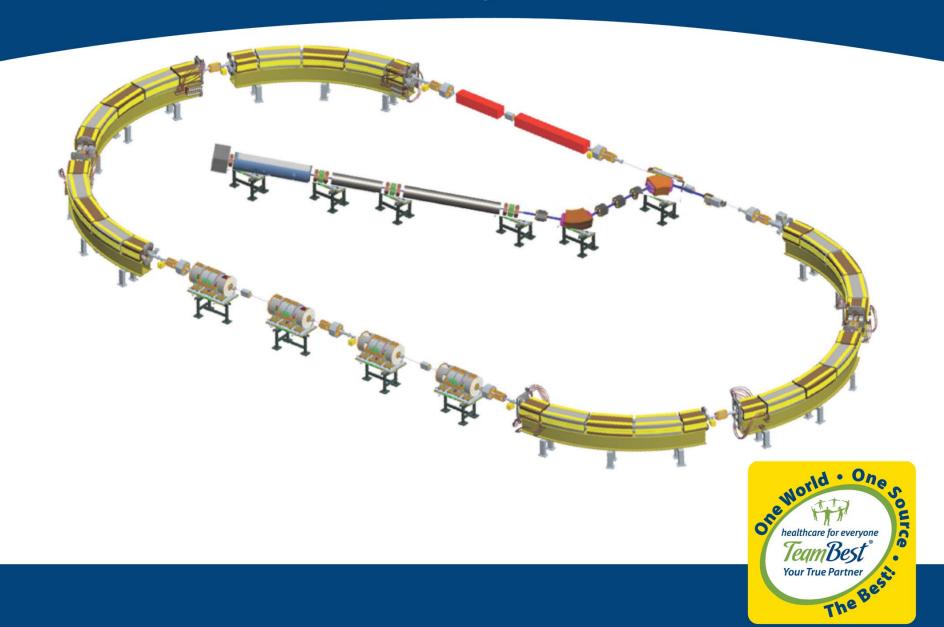




BEST / BNL iRCMS – Much Smaller Footprint



Racetrack Synchrotron



Shielding Estimate Comparisons

	Accelerator Comparison Table								
						Maximum Credible Incidence (MCI)			
1		Energy Maximum (MeV)	Avg. Current Delivered (nA)	Charge Accelerated (nC/s)	Risk Ratio MCI/Delivered	Shielding (50 mSv/yr) Concrete @10.00 m (m)			
	Protons (206 MeV)								
	Isochronous Cyclotron (NC)	230	2	1250	625	2.89			
	Isochronous Cyclotron (SC)	250	2	313	156	2.44			
	Synchro Cyclotron (SC)	250	2	1	0.50	0.54			
	Slow Cycle Synchrotron	250	2	20	10	1.53			
	Rapid Cycle Synchrotron	1200	2	0.133	0.067	0.13			

<u>Estimates above</u> were calculated using the Moyer Model Neutron source terms for 177 MeV protons Neutron transmission factors Neutron attenuation length in concrete (SLAC PUB 130339)

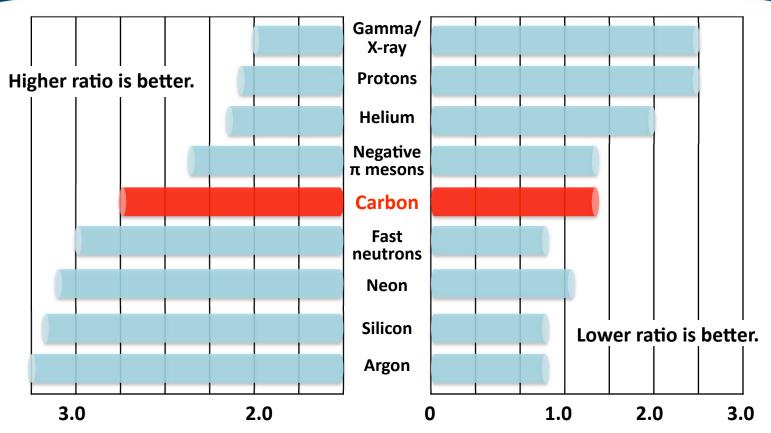
<u>Final shielding calculations</u> use a full scale Monte Carlo method (MCNPX, GEANT, FLUKA)



Prototype iRCMS Combined Function Magnet



RBE: Relative Biological Effectiveness OER: Oxygen Enhancement Ratio

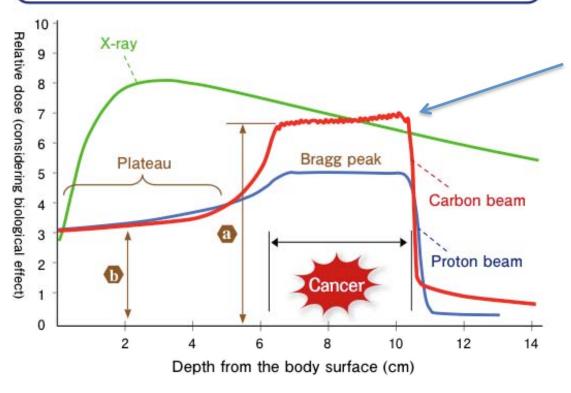


RBE represents the biological effectiveness of radiation in the living body. The larger the RBE, the greater the therapeutic effect on the cancer lesion.

OER represents the degree of sensitivity of hypoxic cancer cells to radiation. The smaller the OER, the more effective the therapy for intractable cancer cells with low oxygen concentration.

Clinical Comparison: X-rays vs. Protons vs. Carbon lons

When the ratios of peak to plateau (a/b) are compared while considering biological effect, the carbon beam has the largest value.

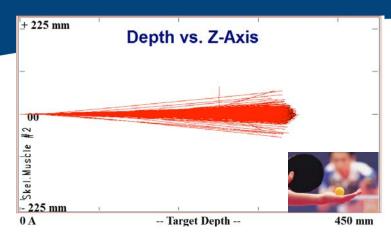


Spread out the Bragg Peak to match tumor volume

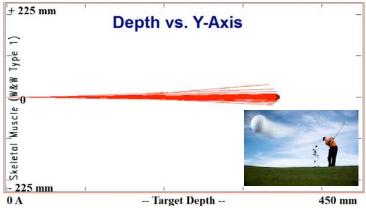
Protons - Base/Peak = 60% Carbon Ions - Base/Peak = 45%



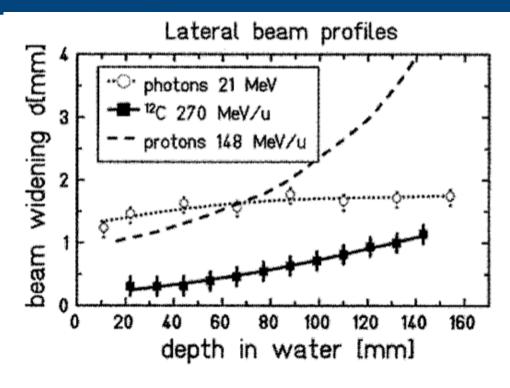
Carbon Ions are more precise than Protons



The intrinsic spot width for ~206 MeV/u protons is $2\sigma = 11.4 \text{ mm}$



The intrinsic spot width for ~400 MeV/u carbon ions is $2\sigma = 2.93$ mm



"Lines to guide the eye" U. Weber GSI (1996)



Cost of facilities construction and operation

Superior dose depth distribution

Physical beam characteristics

- Higher LET
- Superior RBE
- Lower OER
- Narrow penumbra

Radiobiological considerations

- Hypoxia
- α/β ratio
- Metabolism
- Micro-environment
- Cancer stem cells

Considerations for implementing new carbon ion therapy facilities

Relationship to critical structures

- Dose limitations
- Toxicity

Therapeutic gain for specific histologies

- Local control and survival
- Historical responsiveness to current radiotherapy

Dosage and treatment planning

Patient convenience



Medical Advantage

- Deliver 20 times the cancer killing power of protons
- Cure the patient 4 to 10 times faster

Benefit to Patient

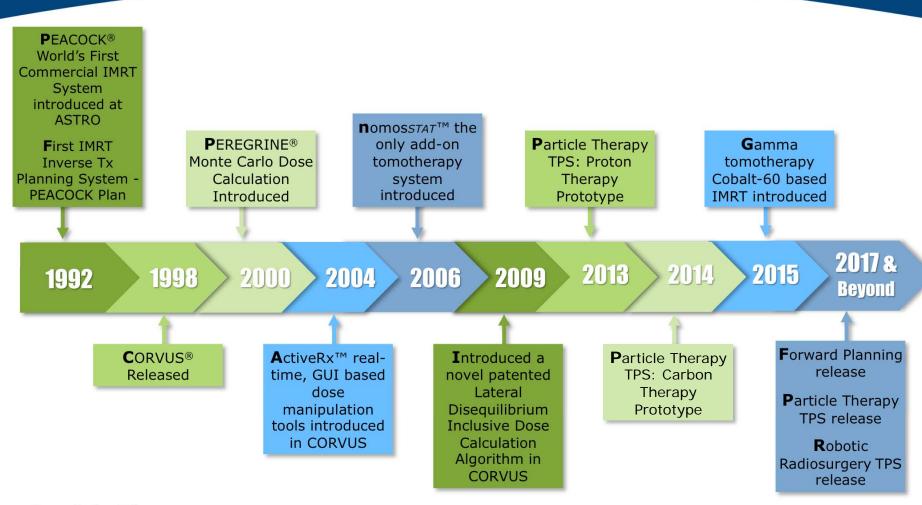
- Shorter treatment times potentially 4 to 10 times less
- Less stress for the patient physically, emotionally & financially
- Less unnecessary radiation exposure

Benefit to Society

 A Heavy Ion Center will provide maximum advantage to the general public by having the capability to treat many more patients than a Proton Center with the same number of treatment rooms

Best Supplies Proton Systems Upgradeable to Carbon!

TREATMENT PLANNING SYSTEM



Particle Therapy:

- Proton and Carbon with Best's Rapid Cycling Synchrotron (collaboration with BNL)
- Algorithm verification in collaboration with MGH

Summary

BMI & BNL have jointly developed a rapid cycling proton/carbon synchrotron that enables advanced features including:

- A unique combination of advanced spot scanning with rapid energy modulation
- Elimination of neutron contamination associated with patient specific hardware

Rapid cycling technology has several natural advantages:

- Intrinsically small beam emittances facilitating beam delivery with unprecedented precision
- Small beam sizes small magnets, light gantries smaller footprint
- Highly efficient single turn extraction
- Efficient extraction, less charge per bunch less shielding
- Flexibility protons and or carbon, future beam delivery modalities



State of the Art Manufacturing Facilities



Exhibitions, Meeting & Trade Shows



AAPM 2016 – Washington, DC



AAPM 2016 – Washington, DC



ASTRO 2016 – Boston, MA



ASTRO 2016 – Boston, MA



ICC 2017 Best Exhibitor Award



Team Best won the
Best Exhibitor Award
at the 2nd Indian Cancer
Congress 2017
Bangalore, India



Recent Recognition



Keynote Speaker – Global Health Catalyst Cancer Summit

April 29, 2016, Harvard Medical School, Boston, MA



Power of One Award - Patcha Foundation

October 29, 2016, Laurel, MD





International Man of the Year Award –U.S. Congressman Danny K Davis's Multi Ethnic Advisory Task Force

October 30, 2016, Meadows Club, Rolling Meadows, IL





Fastest Growing Indian
Company Excellence Award

10th International Achievers
Summit on Global Corporate
Achievements & Social
Responsibilities

Friday, April 20, 2018 Bangkok, Thailand



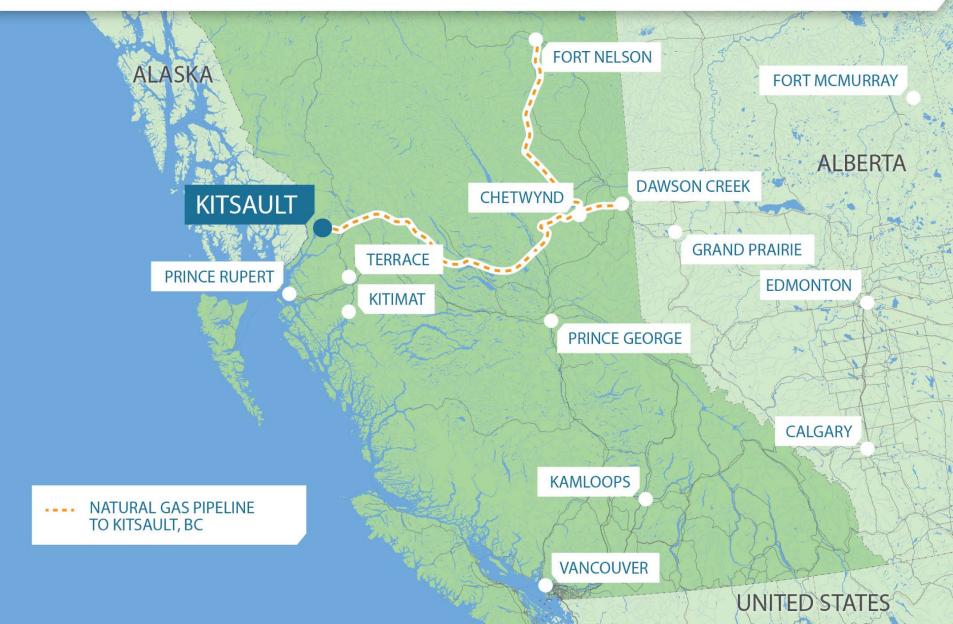






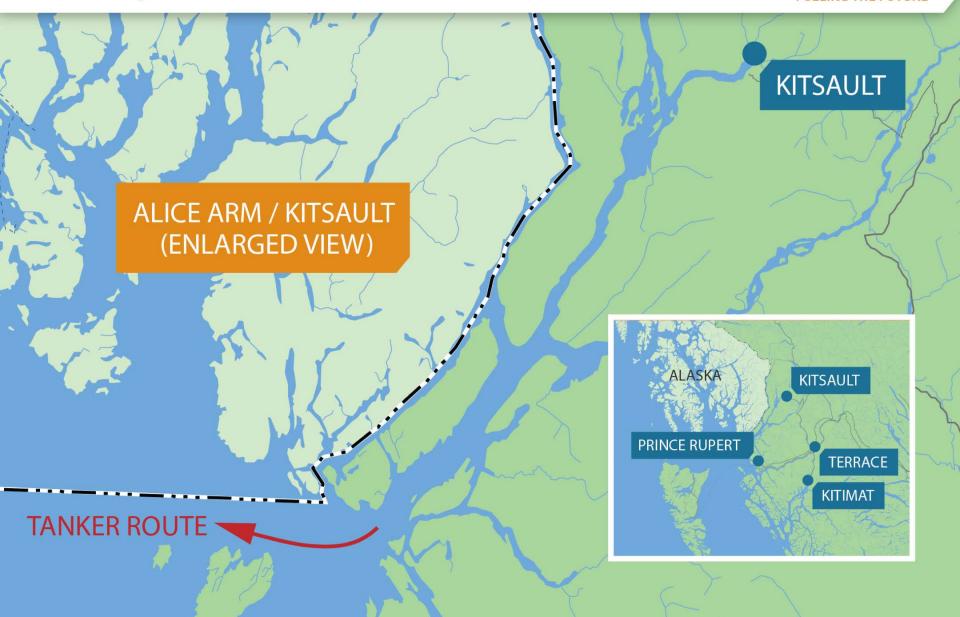






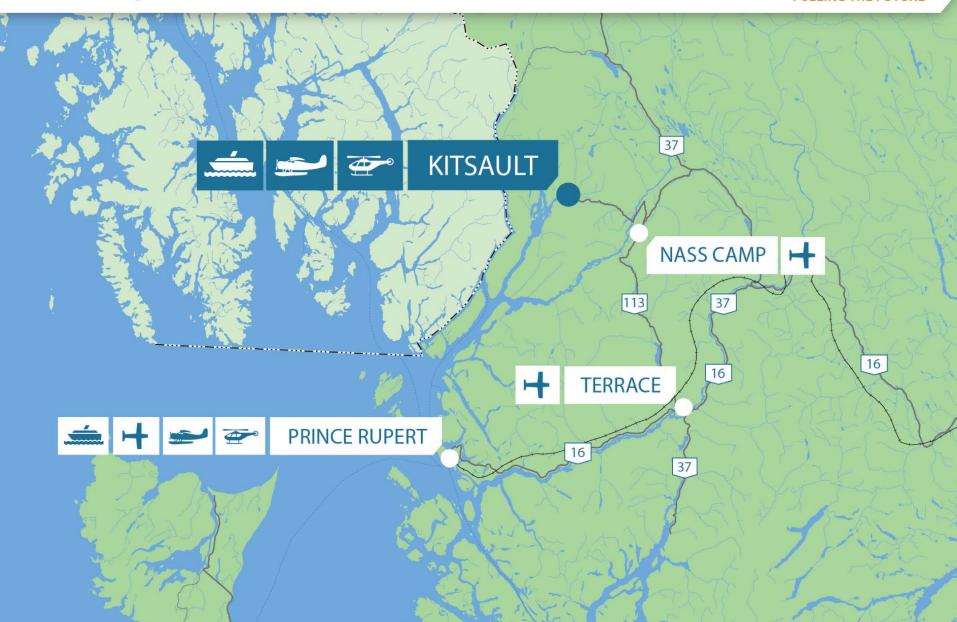
















EXISTING HOUSING INFRASTRUCTURE:

SINGLE FAMILY HOMES

 95 THREE BEDROOM HOMES AVAILABLE.

APARTMENT BUILDINGS

 150 TWO AND THREE BEDROOM APARTMENTS AVAILABLE.

FUTURE DEVELOPMENT

- 30 BUILDING FOUNDATIONS ALREADY IN PLACE.
- VACANT LAND THE POTENTIAL DEVELOPMENT OF PRIME OCEAN AND MOUNTAIN VIEW LOTS.







COMMUNITY INFRASTRUCTURE:

RECREATION CENTRES

- THE 25,000 SQUARE FOOT COMMUNITY CENTRE.
- FOUR SHEET CURLING RINK, MOVIE THEATRE AND A PUB.

SHOPPING CENTRE

 22,000 SQUARE FOOT SHOPPING CENTRE WITH A GROCERY STORE, BANK, AND POST OFFICE

EXECUTIVE HOUSE

 VIP GUEST HOUSEWITH 4 BEDROOMS, 5 BATHROOMS AND A BOARDROOM.

MEDICAL CENTRE

FIRE HALL

INDUSTRIAL BUILDINGS

