LICENCE CONDITIONS FOR ACUTE HOSPITAL SERVICE, AMBULATORY SURGICAL CENTRE SERVICE AND OUTPATIENT MEDICAL SERVICE LICENSEES PROVIDING OR INTENDING TO PROVIDE PROTON BEAM THERAPY

IMPOSED UNDER SECTION 13(1) OF THE HEALTHCARE SERVICES ACT 2020

1. APPLICATION

1.1. These licence conditions ("**LCs**") apply to:

(1) all persons that have been licensed under the Healthcare Services Act 2020 (the "**HCSA**") to provide:

(a) an acute hospital service ("**AHS**");

(b) an ambulatory surgical centre service ("**ASCS**"); and/or

(c) an outpatient medical service ("**OMS**"); and

(2) that provide or intend to provide, as part of the aforementioned service or services, Proton Beam Therapy ("**PBT**") (as defined in clause 2.1(4));

(such persons referred to as "**Licensee(s)**").

1.2. For avoidance of doubt, the defined terms as used in these LCs shall have the meaning ascribed to them in the HCSA and any Regulations made thereunder, unless otherwise stated.

1.3. A breach of these LCs may result in regulatory action being taken against Licensees under section 20 of the HCSA, including but not limited to:

(1) suspension or revocation of the Licensee's licence(s) to provide AHS, ASCS and/or OMS;

(2) shortening the term of the Licensee's licence(s) to provide AHS, ASCS and/or OMS;

(3) a direction requiring the Licensee to rectify the contravention, or prevent a recurrence of the contravention; and/or

(4) a direction requiring the Licensee to pay a financial penalty.

1.4. For avoidance of doubt, these LCs do not override the healthcare professionals' duty to make clinical decisions that are in the best interests of each patient with their valid consent.

1.5. For avoidance of doubt, the requirements in these LCs are without prejudice, and in addition to the requirements imposed under the HCSA as well as any Regulations and other applicable licensing conditions, directions, codes of practice made thereunder.

2. DEFINITIONS

2.1 The following definitions shall apply to these LCs:

(1) "**Core Personnel**" means Radiation Oncologists, Radiation Therapists, Clinically Qualified Medical Physicists ("**CQMPs**"), and Medical Dosimetrists.

(2) "**Facility**" means the approved permanent premises where the Licensee provides, or intends to provide, PBT to patients.

(3) **"Multi-disciplinary cancer treatment programme" ("MCP")** means a collaborative programme with the capability to provide multiple forms of cancer treatment and involves professionals from multiple fields and specialities for the diagnosis, assessment and treatment of cancer, where the types of cancer treatment provided shall include but is not limited to:

(a) other forms of radiotherapy;

(b) surgery; and

(c) medical oncology.

(4) **"PBT"** means the performance of a procedure that involves the application of a high-energy proton beam to a patient in a clinical setting for a therapeutic purpose.

(5) **"physics quality assurance**" means the quality assurance ("**QA**") for PBT-related machines and patient-specific QA.

3. PERSONNEL

3.1 The Licensee shall ensure that PBT is provided to a patient only if there is a sufficient number of qualified personnel commensurate with the workload to allow for safe delivery of PBT, continuity of care and sufficient QA on treatment and processes, to that patient.

3.2 The Licensee shall ensure that the Licensee's Core Personnel:

(1) fulfil and/or comply with the relevant clauses of these LCs; and

(2) understand and acknowledge that they will be required to fulfil and/or comply with the same, before PBT services commence at the Facility.

A. Minimum Personnel

3.3 Before providing PBT to any patient, the Licensee shall:

(1) employ or engage at least two full-time equivalent Radiation Oncologists, where at least one Radiation Oncologist is employed by the Licensee on a full-time basis;

(2) ensure that at least one Radiation Oncologist employed by the Licensee has experience in radiotherapy for at least 10 years prior to his or her employment with the Licensee;

(3) employ or engage at least two full-time equivalent CQMPs, where at least one CQMP is employed by the Licensee on a full-time basis;

(4) make reasonable efforts to employ or engage at least two full-time equivalent Medical Dosimetrists, where at least one Medical Dosimetrist is employed by the Licensee on a full-time basis;

(5) employ or engage at least two full-time equivalent Radiation Therapists, where at least one Radiation Therapist is employed by the Licensee on a full-time basis;

(6) ensure that the Radiation Oncologists mentioned in clauses 3.3(1), 3.2(2) and 3.5, CQMPs mentioned in clauses 3.3(3) and 3.6, Medical Dosimetrists mentioned in clauses 3.3(4) and 3.7, and Radiation Therapists mentioned in clause 3.3(5) have a local track record and experience in providing conventional forms of photon radiotherapy services with image guidance and managing radiation safety. For clarity, if the Licensee employs or engages more than the minimum number of Core Personnel prescribed in those clauses (e.g. 5 full-time equivalent Radiation Oncologists), only two full-time equivalent of each Core Personnel need to fulfil this requirement; and

(7) ensure that at least two CQMPs are onsite at its Facility at any one time during the Licensee's operating hours.

Radiation Oncologist

3.4 The Licensee shall ensure that for any PBT provided to a patient, a Radiation Oncologist is responsible for overseeing the provision of the PBT to that patient by members of a treatment team.

3.5 The Licensee shall ensure that for any PBT provided to a patient, a Radiation Oncologist employed or engaged by the Licensee oversees and manages the overall disease-specific treatment regimen of that patient, including:

(1) ensuring a comprehensive evaluation of disease stage, co-morbidities, previous treatments, and a thorough exploration of various treatment options in consultation with a Tumour Board, to ascertain if PBT is an appropriate treatment for that patient;

(2) ensuring that PBT is used to treat only conditions on the list of approved PBT indications as set out in clause 15 of these LCs;

(3) ensuring that during informed consent taking, there is a comprehensive discussion with the patient regarding alternative treatments, the impact of PBT versus other treatments, including costs, benefits and potential harm;

(4) ensuring the relevant personnel have adequate knowledge of radiation safety before conducting any PBT;

(5) ensuring there is appropriate supervision of a patient's treatment including but not limited to proper patient positioning, immobilisation, accounting for inherent organ motions and contouring the outline of the targets of interest;

(6) conveying case-specific expectations for prescribing the radiation dose to the target volume and set limits on dose to organs at risk (i.e. dose volume histogram) to the personnel responsible for the care of the relevant patient;

(7) approving the final treatment plan of a patient whose treatment is overseen by the Radiation Oncologist in collaboration with a CQMP and Medical Dosimetrist;

(8) supervising the actual treatment process of a patient undergoing PBT;

(9) being responsible for deciding the acceptable or unacceptable day-to-day variations in the treatment setup and to make adaptive changes as necessary to the treatment;

(10) ensuring appropriate long-term follow-up is carried out for patients who have received PBT; and

(11) participating in QA processes, including but not limited to approval of proton therapy assessments, so as to ensure that the intended treatment is being delivered in the prescribed manner.

<u>CQMP</u>

3.6 The Licensee shall ensure that each CQMP involved in the provision of PBT is:

(1) clinically trained in proton therapy;

(2) responsible for directing the PBT radiation oncology physics program, including but not limited to:

(a) directing any Medical Dosimetrist, any other CQMP, therapy equipment service engineer, any other physics support staff personnel, and any Radiation Therapist (as defined in the Licensee's organisational structure) involved in the provision of PBT in their responsibilities relating to the respective aspects of medical physics; and

(b) defining the roles, responsibilities, and reporting status of support staff involved in the provision of PBT;

(3) oversees any technical aspects/components within the Facility; and

(4) responsible for:

(a) the production of proton beams;

(b) the methods of creating a clinically useful dose distribution;

(c) the overall radiation safety within the Facility, including but not limited to:

(i) ensuring the safety of staff employed or engaged by the Licensee and the general public;

(ii) facility shielding;

(d) monitoring for radioactivation of PBT related treatment accessories; and other machine components;

(e) managing the potential impact of secondary radiation on patients; and

(f) performing the operational responsibilities of a Medical Dosimetrist if there are insufficient Medical Dosimetrists onsite at the Facility.

Medical Dosimetrist

3.7 The Licensee shall ensure that each Medical Dosimetrist involved in the provision of PBT is familiar with his responsibilities, which shall include:

(1) contouring clearly discernible organs at risk and any relevant structures that may have dosimetric impact in the proton beam and dose distribution;

(2) ensuring proper handling and orientation of volumetric patient image data on the treatment planning system ("**TPS**") from computed

tomography ("**CT**") and other image data sets, including image registration;

(3) designing and generating an optimal treatment plan when directed by a Radiation Oncologist and under the supervision of a CQMP;

(4) generating approved treatment plan reports and performing plan checks to ensure safe transfer of treatment parameters to the treatment unit via the Oncology Information System;

(5) being available and onsite with a patient receiving PBT at the first treatment; and

(6) assisting with verification for subsequent treatments as necessary, together with the CQMP, where the verification is to be carried out via regular re-CT, as required, for adaptive planning.

Radiation Therapist

3.8 The Licensee shall ensure that each Radiation Therapist involved in the provision of PBT is familiar with his responsibilities, which shall include:

(1) ensuring the proper use of the patient immobilisation/repositioning system and fabricating or preparing them appropriately for proton therapy;

(2) performing initial CT simulation of the patient receiving or intending to receive PBT and generating the imaging data appropriate for the TPS system as part of treatment planning, under the supervision of a Radiation Oncologist and a CQMP;

(3) implementing and delivering the treatment in accordance with the relevant proton therapy treatment plan and under the supervision of a Radiation Oncologist and a CQMP;

(4) ensuring the patient receiving PBT is prepared for treatment;

(5) acquiring periodic verification images for review; and

(6) performing periodic evaluation of the stability and ongoing reproducibility of the immobilisation and patient positioning system and reporting inconsistencies immediately to a Radiation Oncologist and a CQMP.

Supervision of Core Personnel

3.9 The Licensee shall ensure that any CQMP who has less than three years of relevant working experience in active clinical practice shall be involved in the provision of PBT to a patient only under the close supervision of any of the following:

(1) another CQMP with at least three years of relevant working experience in active clinical practice; or

(2) a Radiation Oncologist with experience in radiotherapy for at least 10 years.

3.10 The Licensee shall ensure that any Medical Dosimetrist who has less than three years of relevant working experience in active clinical practice shall be involved in the provision of PBT to a patient only under the close supervision of any of the following:

(1) another Medical Dosimetrist with at least three years of relevant working experience in active clinical practice;

(2) a CQMP with at least three years of relevant working experience in active clinical practice; or

(3) a Radiation Oncologist with experience in radiotherapy for at least 10 years.

4 CREDENTIALING

4.1 The Licensee shall ensure that all the Licensee's personnel involved in PBT (including but not limited to Core Personnel) undergo and comply with an internal credentialing plan, where such an internal credentialing plan shall include relevant continuing professional education relating to PBT.

4.2 The Licensee shall review their Physics Proton Learning and Credentialing Plan ("**PPLCP**") minimally every three years.

A. Radiation Oncologists

4.3 The Licensee shall ensure that each Radiation Oncologist involved in the provision of PBT satisfies the following criteria:

(1) be registered under section 22 of the Medical Registration Act 1997 as a specialist in the branch of radiation oncology;

(2) completed at least one of the following courses (after the first attendance, the Radiation Oncologist shall continue to attend such courses at least once every two (2) years):

(a) any educational course on PBT which is conducted in conjunction with the Particle Therapy Co-Operative Group ("**PTCOG**") Annual Meeting;

(b) European Society for Radiotherapy and Oncology ("**ESTRO**") Particle Therapy Course;

(c) Paul Scherrer Institute (PSI) Winter School for Protons; or

(d) any other courses as approved by the Director-General of Health ("**DGH**") in writing;

(3) have documented proof of fulfilling the criteria in clause 4.3(2); and

(4) completed a period of proctorship in an operational proton therapy centre that is using a similar/the same system or modality relevant to the Licensee, fulfilling the following requirements:

(i) have a training log detailing the Radiation Oncologist's involvement in the direct planning of not less than ten clinically-acceptable cases under supervision of another Radiation Oncologist; and

(ii) completed not less than:

(A) four weeks of attachment with an overseas clinically operational PBT centre found on the PTCOG website, where each period of attachment with an overseas clinically operational centre is not less than two weeks and the overseas clinically operational centre is not a Carbon-ion facility or a facility with low energy beam (i.e. maximum energy of less than 100 MeV); or

(B) three months of attachment with a Licensee approved to provide PBT Services under the HCSA.

B. Clinically Qualified Medical Physicists

4.4 The Licensee shall ensure that each CQMP involved in the provision of PBT complies with the Licensee's PPLCP, where the CQMP's proton specific learning shall include all of the following areas:

(1) acceptance and beam commissioning (theoretical component);

(2) radiation safety;

(3) clinical and physics aspects of treatment planning and treatment;

(4) Physics quality assurance and calibrations; and

(5) management of technical support and maintenance.

4.5 The Licensee shall ensure that each CQMP involved in the provision of PBT satisfies the follow criteria:

(1) completed at least one of the following courses (after the first attendance, the CQMP shall continue to attend such courses at least once every two (2) years):

(a) educational course on PBT conducted in conjunction with the PTCOG Annual Meeting;

(b) ESTRO Particle Therapy Course;

(c) PSI Winter School for Protons; or

(d) any other courses as approved by the DGH.

(2) have documented proof of fulfilling the criteria in clause 4.5(1);

(3) completed the relevant criteria set out in the PPLCP; and

(4) completed a period of proctorship in an operational proton therapy centre that is using a similar/the same system or modality relevant to the Licensee, fulfilling the following requirements:

(a) have a training log detailing the CQMP's involvement in not less than forty clinically approved proton therapy plans;

(b) completed not less than:

(i) four continuous weeks of attachment with an overseas clinically operational centre found on the PTCOG website, where the overseas clinically operational centre is not a Carbon-ion facility or a facility with low energy beam (i.e. maximum energy of less than 100 MeV); or

(ii) three months of attachment with a Licensee approved to provide PBT Services under the HCSA and under the supervision of a credentialed CQMP.

C. <u>Medical Dosimetrists</u>

4.6 The Licensee shall ensure that each Medical Dosimetrist involved in the provision of PBT satisfies the following criteria:

(1) completed a period of proctorship in an operational proton therapy centre that is using a similar/the same system or modality relevant to the Licensee;

(2) have a training log detailing the Medical Dosimetrist's involvement in the planning of not less than forty clinically approved proton therapy plans;

(3) has documented proof of continuing education or credential review for Medical Dosimetrists, to demonstrate evidence of continuing competency; and

(4) completed not less than:

(a) four continuous weeks of attachment with an overseas clinically operational centre found on the PTCOG website, where the overseas clinically operational centre is not a Carbon-ion facility or a facility with low energy beam (i.e. maximum energy of less than 100 MeV); or

(b) three months of attachment with a Licensee approved to provide PBT Services under the HCSA and under a credentialed Medical Dosimetrist or CQMP.

D. Radiation Therapists

4.7 The Licensee shall ensure that each Radiation Therapist involved in the provision of PBT satisfies the following criteria:

(1) is registered with the Allied Health Professions Council;

(2) has completed a period of proctorship in an operational proton therapy centre that is using a similar/the same system or modality relevant to the Licensee;

(3) trained in the setup of the patient and use of the equipment, as demonstrated by a training log; and

(4) completed not less than:

(a) four weeks of attachment with an overseas clinically operational centre found on the PTCOG website, where each period of attachment with an overseas clinically operational centre is not less than two weeks and the overseas clinically operational centre is not a Carbon-ion facility or a facility with low energy beam (i.e. maximum energy of less than 100 MeV); or

(b) three months of attachment with a Licensee approved to provide PBT Services under the HCSA and under the supervision of a credentialed Radiation Therapist.

5 CONTINUED PRIVILEGING

5.1 The Licensee shall have a process to review the credentials and privileges of Core Personnels who are providing clinical PBT on an ongoing basis.

5.2 The Licensee shall implement processes to ensure that personnel involved in clinical practice maintain currency and competency in clinical practice, including

but not limited to processes to ensure that the Core Personnel have at least three years in active clinical practice.

6 PROCESS OF THERAPY

6.1 The Licensee shall provide PBT to patients only if the Licensee is able to demonstrate competency in PBT treatment process, including but not limited to:

(1) proton beam delivery;

(2) treatment planning;

(3) dose calibration and calculation; and

(4) using phantom for proton treatment simulation.

A. Proton Beam Delivery

6.2 The Licensee shall only provide PBT to patients using proton beams with dose calibration and dosimetry that comply with:

(1) any relevant Singapore legislation, if any;

(2) the international guidelines by the International Commission on Radiation Units and Measurements ("**ICRU**"), and

(3) the international guidelines by the International Atomic Energy Agency ("**IAEA**"),

where any relevant dose or dosimetry audit meets both ICRU (Report No. 78) and IAEA (Report No. 398) standards.

B. Treatment Planning

6.3 The Licensee shall provide PBT to patients only if:

(1) proton dose calculations for treatment planning are based on CT data acquired from a CT scanner that has been specifically calibrated for proton therapy;

(2) periodic QA of the CT number to relative linear stopping power ("**RLSP**") function are performed for each CT scanner.

(3) guidelines and policies regarding the tolerances of CT number and RLSP variations in the periodic QA checks have been established by the Licensee (Licensees can take reference from this document: American Association of Physicists in Medicine, Task group 224: Comprehensive Proton Therapy Machine Quality Assurance");

(4) each patient is provided with treatment site-specific immobilisation device(s) and CT imaging is performed for treatment dose planning and treatment;

(5) the treatment planning system is able to register CT images with images from all imaging modalities used by the Licensee;

(6) a motion management program relevant to imaging and treatment planning is established for patients for whom motion may be an issue;

(7) the treatment planning system used for proton treatment is commissioned and validated; and

(8) planning system calculations have been verified by phantom measurements during the commissioning process.

C. Tumour Board

6.4 The Licensee shall provide PBT to a patient (including for purposes of clause 15, 16 of these LCs, or otherwise) only if a Tumour Board comprising at least one specialist from each of the following disciplines, and where the members of that Tumour Board are not directly involved in the direct care of the patient, has assessed the suitability of PBT for that patient:

(1) surgical oncology;

(2) medical oncology (or paediatric oncology),

(3) radiation oncology,

(4) radiology, and

(5) pathology (if appropriate).

D. Service Review Committee ("**SRC**")

6.5 The Licensee shall only provide PBT upon the appointment of a SRC comprising the following members:

(1) a Radiation Oncologist who is independent of the Licensee; and

(2) at least two other members.

6.6 The Licensee shall provide PBT only if the SRC:

(1) ensures the appropriate use for proven clinical indications listed in clause 15;

(2) ensures tracking of long-term outcomes, with reference to the data set out in clause 14;

(3) identifies and investigates any non-compliance with these LCs;

(4) where necessary, makes recommendations to ensure the Licensee's compliance with these LCs;

(5) monitors the implementation and effectiveness of any recommendations by the SRC; and

(6) carries out any such activity as may be directed by the DGH.

7 POLICY AND PROCEDURES

7.1 Before providing any PBT to patients, the Licensee shall establish the following policies and procedures:

(1) philosophy, objectives and scope of the PBT;

(2) organisation structure of the Licensee;

(3) plans for the future development of services and staffing needs;

(4) staff development and education programmes;

(5) staff training and validating relevant skills of staff;

(6) maintenance and use of facilities and equipment;

(7) assessment of radiation safety for all staff, including but not limited to non-medical staff who have access to PBT facilities;

(8) emergency and contingency plans, including but not limited to the speed of activating such emergency and contingency plans;

(9) aseptic practices;

(10) infection control;

(11) incidents and adverse events reporting, root cause analysis and rectification procedures; and

(12) work instructions and standard operating procedures (SOPs) for critical processes.

7.2 The Licensee shall comply with any request or direction from the DGH to submit treatment protocols for the provision of PBT to DGH or the Ministry of Health for the DGH's review and approval. The Licensee shall provide PBT only in compliance with such treatment protocols as reviewed and approved by the DGH.

8 CLINICAL COMMISSIONING PRIOR TO COMMENCEMENT OF OPERATIONS

8.1 Before providing any PBT to patients, the Licensee shall:

(1) ensure there is a process in place to evaluate or review its clinical readiness prior to commencement of patient treatments, where the areas of evaluation or review shall include:

(a) clinical application of PBT;

(b) impact on workflows, equipment, staffing, space utilisation, and possible new QA procedures, once operations commence;

(2) demonstrate competency in PBT and conduct phantom testing for proton treatment simulation;

(3) ensure that any new procedure, technique, system, accessory, or technologies has been acceptance tested, commissioned, and released for clinical use by the CQMP with the appropriate documentation prior to implementation;

(4) ensure that all commercial products (including but not limited to hardware, software, or accessory) to be used by the Licensee to provide PBT have been approved by the Health Sciences Authority where necessary;

(5) develop and implement processes for conducting safety testing and verification that any system or device to be used by the Licensee to provide PBT meets the manufacturer's performance standards;

(6) ensure that commissioning of any system or device to be used by the Licensee to provide PBT includes implementation of a QA program to demonstrate the consistent safety and performance of the system or device, where necessary; and

(7) ensure that the quality improvement program associated with any new procedure shall be periodically reviewed and updated.

9 RADIATION SAFETY AND ENVIRONMENTAL SUSTAINABILITY

9.1 The Licensee shall provide PBT to patients only if:

(1) the Licensee is licensed in accordance with the Radiation Protection Act 2007 ("**RPA**");

(2) the radiation shielding of the Licensee meets current standards specified under the RPA;

(3) parts that have become radioactive over time during operations (activated parts) are properly stored, monitored, managed, and disposed or re-exported in a safe and environmentally friendly manner;

(4) the Licensee takes into account any issues surrounding the decommissioning and dismantling of the Facility (or any part of the Facility thereof) and/or PBT equipment when the Facility (or any part of the Facility thereof) and/or equipment have reached the end of their useful life, including but not limited to disposal of concrete / steel shielding that may be activated; and

(5) personnel are monitored for accumulated exposure to radiation.

10 MAINTENANCE OF FACILITY AND EQUIPMENT

10.1 The Licensee shall provide PBT to patients only if:

(1) the Facility and equipment are maintained in good operating condition and are fit for safe clinical use at all times;

(2) equipment are calibrated, maintained, monitored for proper function and used in accordance with the manufacturer's specifications. For the avoidance of doubt, the time interval for proton beam-related equipment maintenance activities not be less than the time interval recommended by the relevant manufacturer;

(3) equipment problems are promptly addressed;

(4) appropriate cleaning of all equipment is carried out routinely; and

(5) an acceptance and commissioning of any proton equipment shall be carried out at the time of initial installation and where there is any change or alteration to the configuration of the Facility or proton equipment that could affect the proton beam output, patient treatment, or radiation safety.

11 DOCUMENTATION

A. Staff Records

11.1 The Licensee shall properly document and maintain the record of the Licensee's personnels' roles, qualifications, competency assessments and training records, including exposure dose monitoring records for all radiation staff.

11.2 The Licensee shall ensure that radiation monitoring records of the Facility and staff exposures are updated in a timely manner.

B. Radiation Licences and Records

11.3 The Licensee shall properly document and maintain the record of all required licence(s) and authorization(s) from the Radiation Protection and Nuclear Science Department, National Environment Agency ("**NEA**") in relation to the use of irradiating apparatus.

11.4 The Licensee shall keep comprehensive and accurate radioactive waste disposal records.

C. Quality Records

11.5 The Licensee shall:

(1) ensure that all documents relating to QA and any treatment of any patient receiving, or has received, PBT from the Licensee are available in paper or electronic form;

(2) keep a record of all quality control measures, including but not limited to the maintenance of equipment, certification of facility and equipment by any external vendor;

(3) prepare an annual summary report on each gantry beamline;

(4) ensure that the delivery system is functioning as expected, in accordance and consistent with the initial acceptance and commissioning performance;

(5) keep a record of any investigations and follow-up actions of adverse reactions associated with proton beam therapy; and

(6) submit treatment protocols as may be requested by the DGH from time to time.

D. Alternative Treatment Centres

11.6 The Licensee shall keep a written record of the plans prescribed under clause 13.1, including arrangements made with any other licensees for the provision of services.

12 QUALITY ASSURANCE

A. Principles on Developing QA for PBT

12.1 The Licensee shall provide PBT to a patient only if:

(1) a record and verify system to keep track of the treatment charts and delivered dose for that patient is implemented by the Licensee, where routine chart checks shall be performed by a staff member of the physics team, under direct supervision of a CQMP; and

(2) the Licensee develops policies and procedures on proton therapy QA in accordance with failure mode and effects analysis ("**FMEA**") principles.

12.2 After PBT is provided to a patient, the Licensee shall ensure that an end-of-treatment review for that patient is performed within one week of the treatment completion by a staff member of the physics team, and under the direct supervision of a CQMP.

B. Patient-specific QA

12.3 The Licensee shall provide PBT to patients only if:

(1) policies and procedures related to quality, patient education, infection control, and safety have been developed and implemented by the Licensee;

(2) every patient's treatment charts (physical or electronic) are reviewed under the supervision of a CQMP prior to the start of any treatment of that patient; where the review shall include prescription, site, range (energy), and other treatment parameters;

(3) patient-specific Physics QA are done for every patient plan, and shall include:

(a) either measured or derived parameters from the beam delivery system that show the accuracy and consistency (delivered dose and beam positioning) of the intended treatment; and

(b) an independent dose calculation check;

(4) any QA applied to ensure the safe operation of the proton therapy system as a whole explicitly addresses aspects requiring specific mitigations to achieve a safe system, as identified during the FMEA;

(5) the frequency of QA tests from the likelihood and severity of the identified risks are derived, where the most likely failure modes that can cause harm to the patient or personnel shall be tested more frequently;

(6) there are processes in place for the long-term follow-up for all patients who have undergone PBT, including the monitoring of delayed toxicities and ensuring that clinical outcomes of all patients are reported back to the Licensee by the Radiation Oncologist and the medical practitioner of the primary discipline that the patient is under.

C. Machine QA

12.4 The Licensee shall provide PBT to patients only if:

(1) all elements of the regular machine QA program and its results are documented;

(2) there are proper documented QA processes for the use of treatment equipment and patient specific devices, including but not limited to apertures and compensators;

(3) dosimetry equipment used for proton calibration meet the same requirements as for photon beams;

(4) chambers and electrometers are calibrated by a primary standard dosimetry laboratory with a frequency of either:

(a) not more than two years; or

(b) not more than five years, where the Licensee is conducting yearly stability checks, external dose audits or inter-comparison with a secondary standard dosimetry laboratory;

(5) QA on the proton treatment planning system to check the CT calibration, treatment unit configuration parameters and a sub-set of basic beam data is carried out at least once a year;

(6) additional treatment site-specific and manufacturer-specific QA recommendations are adopted, if any;

(7) the rationale for any deviations from the additional treatment site-specific and manufacturer-specific QA recommendations is clearly documented and approved by the supervising CQMP;

(8) a subset of commonly used treatment parameters at the treatment rooms are incorporated into the QA program; and

(9) the exact parameters of the subset of commonly used treatment parameters at the treatment rooms are reviewed periodically and adjusted to reflect changes in treatments being offered by the Licensee to patients, including but not limited to the following parameters:

(a) functioning of the major scattered beam and/or scanned beam interlocks is confirmed;

(b) user-insertable devices are properly latched;

(c) periodic evaluation of the mechanical features of any beam applicator/range shifter and applicator/range shifter carriage shall be documented;

(d) there shall be an established and documented method of addressing motion management;

(e) patient-specific devices used in patient treatment for conforming the beam to the target shall have documented QA and verification procedures; and

(f) there is a documented method to translate the prescribed dose into monitor units and/or other delivery parameters.

D. External Quality Assurance Program

12.5 The Licensee shall carry out the following prior to the renewal of the license:

(1) participate in and pass an external quality assurance program; and

(2) participate in periodic inter-institutional dosimetry inter-comparisons.

13 ENSURE CONTINUITY OF TREATMENT DURING EXTENDED DOWNTIME

13.1 The Licensee shall provide PBT to patients only if the Licensee has developed and implemented plans to ensure continuity of treatment during extended downtime, including but not limited to plans for alternative treatment sites and modalities of radiotherapy to ensure continuity of treatment to that patient in the event of extended downtime.

14 SURVEILLANCE DATA

14.1 The Licensee shall collect the following data:

(1) number of patients treated through the use of PBT;

(2) recommended dosage of PBT for each patient; while taking into consideration logistical difficulties and combined toxicities;

(3) whether the PBT has been completed within the treatment schedule planned by the Licensee;

(4) time period between the date the patient has consented to be treated through PBT and the date that PBT is initiated for the relevant patient;

(5) clinical indication for use;

(6) dose delivery approach;

(7) usage of general anaesthesia and sedation during PBT;

(8) treatment protocols used for PBT;

(9) documentation on intent of treatment and the expected patient prognosis;

(10) three to five year overall survival adjusted by stage and histology;

(11) recurrence rate of tumours in PBT-radiated sites;

(12) progression-free survival, which is the length of time from the initiation of PBT treatment where there is no progression of the relevant disease for which the patient is or was receiving treatment through PBT;

(13) tumour local control;

(14) acute and late toxicity, where acute toxicity refers to that with onset within the first 90 days, while late toxicity refers to that with onset after 90 days of completion of PBT treatment, specific to the tissues involved;

(15) location and rate of formation of secondary malignancies, including but not limited to radiation-included tumours;

(16) rate of tumour metastases;

(17) disease-free survival (which includes remission of cancer)

(18) number of serious reportable events arising from PBT which are reportable to the Ministry of Health under the Quality Assurance Committee framework;

(19) number of radiation accidents arising from PBT which are reportable to NEA under the RPA;

(20) pubertal delay for paediatric patients; and

(21) other relevant functional complications relating to quality-of-life in paediatric patients, including but not limited to IQ/cognitive failure and hearing loss.

14.2 The Licensee shall, if requested, provide any or all of the surveillance data mentioned in clause 14.1, in such form and manner as DGH may direct, to the Ministry of Health, DGH or such person or entity as DGH may stipulate.

15 INDICATIONS ALLOWED FOR USE OF PBT IN TREATMENT

15.1 The Licensee shall provide PBT to patients in clinical treatment only for the indications set out in this clause 15.

15.2 **Cancer subtypes for all ages**

(1) Musculoskeletal system

(a) Base of skull chordoma
(b) Base of skull chondrosarcoma
(c) Spinal and paraspinal bone and soft tissue sarcoma
(d) Non-metastatic retroperitoneal sarcomas

(2) Central and peripheral nervous system

(a) Ependymoma
(b) Pituitary adenoma
(c) Acoustic neuroma
(d) Base of skull meningioma

(3) Lymphatic system

(a) Localised follicular lymphoma

(4) Head and neck

(a) Advanced (e.g., T4) and/or unresectable head and neck cancers
(b) Cancers of the paranasal sinuses and other accessory sinuses

(5) Oesophageal cancer

(6) Oropharyngeal cancer

(7) Prostate cancer

(8) Advanced high risk inoperable hepatocellular carcinoma

(9) Locally advanced cancers undergoing concurrent chemoradiation therapy

15.3 **Cancer subtypes for patients younger than 25 years only**

(1) Central and peripheral nervous system

(a) Retinoblastoma
(b) Medulloblastoma
(c) Chordoma/ chondrosarcoma base of skull or spine
(d) Ependymoma
(e) Craniopharyngioma
(f) Intracranial germ cell tumour
(g) Primitive neuroectodermal tumours
(h) Esthesioneuroblastoma
(i) Neuroblastoma
(j) Pineal parenchymal tumours (not pineoblastoma)
(k) Glioma

(2) Musculoskeletal

(a) Ewing sarcoma
(b) Spinal/ paraspinal bone and soft tissue sarcoma
(c) Rhabdomyosarcoma: orbit, parameningeal, head and neck, pelvis

(d) Pelvic sarcoma
(e) Osteosarcoma

(3) Salivary gland cancer

16 CLINICAL RESEARCH OR OTHER USES OF PBT

16.1 The Licensee shall only provide PBT to patients for any indication that is not listed in clause 15 as part of clinical research or following an ethics review by a clinical ethics committee (where applicable).

16.2 The Licensee shall provide the PBT mentioned in clause 16.1 to patients only with approval by the local Institutional Review Board or the clinical ethics committee (where applicable).

16.3 The Licensee shall ensure that all research related to PBT complies with the Human Biomedical Research Act 2015 and any other relevant legislation, including but not limited to Health Products (Clinical Trials) Regulations.

16.4 Where a patient is referred to a clinical ethics committee, the Licensee shall ensure compliance with the Licence Conditions on Case Reviews by Clinical Ethics Committee and maintain records of the review and decisions by the clinical ethics committee.

17 MCP FOR PBT SERVICE

17.1 The Licensee shall:

(1) provide PBT to patients only as part of a MCP in Singapore;

(2) provide PBT (including for purposes of clause 15, 16 of these LCs, or otherwise) to a patient only if that patient is enrolled in a MCP under the care of a multi-disciplinary team;

(3) prior to providing PBT to a patient, ensure that a Tumour Board carries out a holistic review regarding the available treatment options and overall patient management of that patient and as part of the MCP ("**MCP review**");

(4) ensure that each MCP review is carried out with inputs from all relevant medical specialists, where the medical specialists to be consulted shall minimally include a specialist from each of the following disciplines:

(a) surgical oncology;

(b) medical oncology (or paediatric oncology);

(c) radiation oncology;

(d) radiology; and

(e) pathology (if appropriate);

(5) not provide PBT to a patient unless the entities and/or individuals who have conducted that patient's MCP review have endorsed the use of PBT for that patient, where the said entities and/or individuals have taken into consideration the other treatment options available as part of the MCP review;

(6) properly document that the following have been considered as part of the MCP review in relation to PBT provided to a patient, and maintain such documentation as part of that patient's medical records:

(a) name and specialty of each medical practitioner involved in the MCP review;

(b) the reasons for not consulting with a relevant medical specialist(s), if any were not so consulted;

(c) patient information reviewed as part of the process;

(d) the treatment(s) that the patient had undergone and the outcome of each treatment(s);

(e) other possible treatment option(s) for that patient's cancer (including other forms of radiotherapy), and the reason(s) why these were not considered to be suitable; and

(f) the overall treatment and care plan for that patient, including any non-PBT treatment(s) (whether as an alternative, concurrent or adjuvant treatment);

(7) ensure that any patient or referral who is not enrolled in a MCP and/or has not had a MCP review conducted (e.g. oncology patients who may present directly to the Licensee's premises, including overseas patients) is referred to a MCP for a MCP review or back to the patient's existing MCP to rectify any gaps. For clarity, the Licensee may also engage the MCP on behalf of the patient;

(8) convey any new patient information not known to the entities and/or individuals conducting that patient's MCP review at the time the said MCP review was conducted and which may have impact on the decision to perform PBT or any other treatment(s), to the entities and/or individuals who had conducted that MCP review;

(9) refer the patient to an alternative treatment provider for further care if treatment by the Licensee is assessed to be unsuitable, where the alternative treatment provider may include, but is not limited to, any other treatment provider participating in the MCP that patient is enrolled in, the patient's primary physician, or another radiotherapy provider (including

another Licensee providing PBT), where such referral shall be made while considering the patient's profile and preference;

(10) work with the other entities/individuals participating in the MCP a patient is enrolled in:

(a) on the follow-up and management of non-PBT aspects of care, both during the period that patient is receiving PBT treatment and after the conclusion of that patient's PBT, including but not limited to both clinical (e.g. pain management, rehabilitation, concurrent therapies) and non-clinical aspects (e.g. social work) of care; and

(b) tracking of surveillance data (as set out in clause 14 of the RTCs).

(11) The Licensee shall ensure clear communication of the plans described in clause 17.1(10) to the patients.