THE QUEEN'S MEDICAL CENTER

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March 17, 2011

Nuclear Materials Licensing Branch
U.S. NRC Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Docket: 030-14522
License: 53-16533-02

RE: Amendment Request to add Y-90 SIR-Spheres microspheres and SIR-Spheres Authorized Users

Greetings:

Please amend our radioactive materials license to include Yttrium-90 (Y-90) microspheres as Model Sirtex Medical Limited SIR-Spheres manufactured by Sirtex Medical Ltd. Specifically, we request authorization for maximum possession limits of 189 mCi per vial and 5 vials of Sir-Spheres for the anticipated administration into malignant hepatic tumors. Technical data pertaining to this sealed source is enclosed.

Amendment request #1:

Byproduct, source, and/or special nuclear material	**Chemical and/or physical form**	**Maximum amount that licensee may possess at any one time under this license**
Yttrium-90 permitted by 10 CFR 35.1000	**Sealed source, Model Sirtex Medical Ltd SIR-Spheres microspheres**	**189 millicuries per vial, 5 vials total**

Specific information on radiation safety aspects concerning this 35.1000 byproduct material amendment are enclosed:

a. SIR-Spheres Radiation Safety Procedure
b. SIR-Spheres dose measurement procedure
c. Radiation safety equipment

The Y-90 SIR-Spheres microspheres will be used at The Queen's Medical Center and ordered and administered only by Authorized Users qualified by 10 CFR 35.390 or 10 CFR 35.490. Specifically, we request to add Marc N. Coel, M.D. and Douglas Prager, M.D. as Authorized Users for therapeutic administration of SIR-Spheres microspheres. Both physicians have completed microsphere-specific training provided by Sirtex Medical Ltd for new users and are presently listed on our license for 35.300 use. Documentation pertaining to this microsphere-specific training is enclosed.

Amendment request #2:

Authorized User	Material and Use
Marc N. Coel, M.D.	**35.1000 only in Yttrium-90 Sirtex SIR-Spheres microspheres**
Douglas Prager, M.D.	**35.1000 only in Yttrium-90 Sirtex SIR-Spheres microspheres**

Please contact our Radiation Safety Officer at (808) 547-4884 if any additional information is necessary to expedite our license amendment. Thank you very much for your assistance.

Sincerely,

Darlena Chadwick
Vice President, Patient Care

Enclosed:
(1) Y-90 SIR-Spheres brachytherapy device technical data
(2) SIR-Spheres Radiation safety information
(3) Training certification for Dr. Coel, Dr. Prager

SUBJECT: Y-90 Microsphere Therapy
Radiation Safety Policy/Procedure

1.0 PURPOSE

This procedure provides instructions and guidance to assure adequate radiation safety during selective internal radiation therapy (SIRT) involving Yttrium-90 (Y-90) microspheres.

2.0 SCOPE

This procedure applies to all Y-90 microsphere therapies performed at The Queen's Medical Center (QMC). This procedure is also supplemented by current Radiation Safety policies and procedures as applicable: "Radiopharmaceutical Therapy Procedures", "Radiopharmaceutical Quality Management Program", "Safe Use of Radiopharmaceuticals", "Radiopharmaceutical Spill Procedures", and "Radioactive Waste Disposal".

3.0 PROCEDURE

3.1 PERSONNEL

3.1.1 Primary personnel include the Interventional Radiologist, Nuclear Medicine Authorized User, Nuclear Medicine Technologist, and the Radiation Safety Officer. Primary personnel must be approved by the Radiation Safety Committee (RSC) to perform or assist with these procedures.

The Radiation Safety Officer will maintain records related to RSC approval of primary personnel.

3.1.2 Ancillary personnel include the Special Procedures radiologic technologists and nursing staff.

3.2 TRAINING

3.2.1 All personnel directly involved with the Y-90 SIRT procedure will receive appropriate instruction prior to assuming duties and whenever there is a significant change in duties, applicable regulations, or the therapy device procedures.

3.2.1.1 Authorized Users

Authorized Users must meet the training and experience requirements of either 10 CFR 35.390 or 10 CFR 35.490 as well as the specific vendor training in the use of the microspheres and the microsphere delivery system before performing these procedures.

For new Authorized Users, the first three (3) patient cases completed by the individual will be hands-on and supervised in the physical presence of a manufacturer representative for each type of Y-90 microsphere for which the individual is authorized.

3.2.1.2 Primary Personnel

The initial primary personnel and the Radiation Safety Officer will receive device-specific training from the manufacturer. The vendor will be present

during at least the first two (2) procedures conducted at QMC. These initial primary personnel will then be approved by the RSC.

Future primary personnel must receive device-specific, manufacturer-equivalent training from either the manufacturer or primary personnel already approved by the Radiation Safety Committee, assist in three (3) documented procedures, and be approved by the Radiation Safety Committee before serving as primary personnel during these procedures.

3.2.1.3 Ancillary Personnel

Initial ancillary personnel will receive device-specific training from the vendor. Future ancillary personnel will receive training from the vendor, initial primary personnel, initial ancillary personnel, or the Radiation Safety Officer.

3.2.2 The training material will include (but not limited to):

- Hazards associated with radiation/radioactive materials;
- Size and appearance of radioactive sources;
- Procedures to minimize radiation exposure;
- Procedures for visitor control;
- Patient release criteria (10 CFR 35.75);
- Written Directive and Quality Management Program;
- Procedures for notification of appropriate personnel if patient has medical emergency or dies;
- Appropriate response to an unusual occurrence that may involve exposure to radiation or radioactive material; and
- Worker responsibility to report promptly any condition that may lead to unnecessary radiation exposure or violation of regulations.

3.2.3 The Radiation Safety Officer will maintain records of individuals receiving training, a description of the training (such as the lecture outline), the training date, and the name of the individual(s) providing the training. Records will be maintained for at least three (3) years.

3.2.4 Before being released from inpatient care, the patient will be provided with instructions that will support efforts to maintain radiation exposure to household members and the public ALARA (as low as reasonable achievable) per the requirements of 10 CFR 35.

3.3 DESCRIPTION OF DUTIES

3.3.1 Interventional Radiologist/Nuclear Medicine Authorized User

- Calculates required activity (mCi or GBq) based on intended dose for specific patient.
- Completes written directive that includes prescribed activity. **(AU only)**
- Prepares patient for dose delivery.
- Verifies patient's identification, dose prescription, and completes quality assurance form (QA checklist). **(AU only)**
- Assembles microsphere delivery system.
- Ensures delivery system assembled correctly.
- Delivers microsphere dose. **(AU only)**
- Ensures delivered dose is in agreement with prescribed dose. **(AU only)**
- Assists in disposal of delivery system.

3.3.2 Special Procedures Radiologic Technologist (SPRT)

- Prepares room for procedure. The Interventional Radiology (IR) suite will be draped with disposable coverings to aid in clean up of possible contamination.
- Retrieves sterile delivery system set from Nuclear Medicine.
- Assists interventional radiologist with assembly of delivery system.
- Assists interventional radiologist with ensuring delivery system assembled correctly.

3.3.3 Nuclear Medicine Technologist

- Orders radioactive material from manufacturer.
- Receives and processes package of radioactive material from manufacturer.
- Provides sterile delivery system set to Special Procedures.
- Assays radioactive material in shipping vial.
- Draws up patient dose for use in delivery system. Appropriate shielding and remote handling tools will be utilized.
- Verifies patient dose is in agreement with prescribed dose prior to patient delivery. The patient dose will be dispensed into the "V" vial supplied, be in appropriate shielding and labeled with date, nuclide, patient name, and "Sirspheres".
- Delivers dose to Special Procedures. Appropriate shielding (the manufacturer's beta shield container) will be utilized to keep radiation exposure to personnel ALARA.
- Performs final assay of remaining dose to determine amount delivered to patient.

3.3.4 Radiation Safety Officer/Medical Physicist

- Assists SPRT with preparing the IR suite to control contamination.
- Oversees patient dose preparation to ensure correctness of the dose.
- Ensures personnel wearing dosimeters.
- Ensures proper radiation monitoring equipment is available.
- Ensures container for waste disposal is available.
- Assists AU in completing quality assurance form.
- Ensures proper shielding and safe handling procedures used during procedure.
- Monitors delivery system during dose delivery.
- Determines when maximum dose has been delivered.
- Measures exposure rate 1 meter from patient.
- Performs surveys of hands, feet, and clothing of all individuals leaving room.
- The "Caution Radioactive Material" form for permanent implants will be completed and included in the patient's chart. Instructions for nurses shall be included in the patient's chart.
- Collection and identification of all radioactive waste.
- Surveys room for contamination following removal of patient.
- Decontaminates contaminated areas.
- Logs all radioactive waste and places it in storage for decay.

3.4 WRITTEN DIRECTIVE AND WRITTEN RECORD

3.4.1 The written directive shall include the patient's name; the date; the signature of an AU for Y-90 microspheres; the treatment site; the radionuclide (including the physical form [Y-90 microspheres]); the prescribed dose/activity; the manufacturer; and, if appropriate for the type of microsphere used, the statement "or dose/activity delivered at stasis."

3.4.2 The written directive should specify the maximum dose(s)/activity(ies) that would be acceptable to the specified site(s) outside the primary treatment site due to shunting (e.g. lung and gastrointestinal tract).

3.4.3 Administration of Y-90 microspheres must be performed in accordance with the written directive.

3.4.4 The administered dose/activity delivered to the primary treatment site will be recorded in the written record and signed by an AU for Y-90 microspheres. The administered dose/activity delivered to the other specified site(s) will be recorded in the written record, as applicable.

3.4.5 The written record will be prepared within 24 hours after the completion or termination of the administration.

3.4.6 If the administration was terminated because of stasis, then the total dose/activity to the treatment site is the value of the total dose/activity administered when stasis occurred and the administration was terminated. Furthermore, the written record will include the name of the individual who made the assessment, the date, and the signature of an AU for Y-90 microspheres.

3.5 RADIATION SAFETY DURING DOSE DELIVERY

3.5.1 All personnel entering the treatment room will wear protective equipment as needed, including scrubs, disposable gown, hair net, face mask, gloves, shoe covers, and, during fluoroscopy, lead aprons and thyroid shields.

3.5.2 All personnel will wear radiation dosimeters.

3.5.3 The patient will be covered with large drapes and the floor next to the treatment table will be covered with plastic-backed absorbent paper.

3.5.4 Radioactive waste will be disposed in a designated container. Regular waste should not be mixed with radioactive waste.

3.6 POST-THERAPY RADIATION SAFETY

3.6.1 Following therapy, the exposure rate from the patient will be measured at one meter to assure it is below 2 mR/hour.

3.6.2 Provided the patient exposure rate is less than 2 mR/hr at one meter, there are no restrictions if the patient is admitted to the hospital. However, pregnant staff will not provide patient care.

3.6.3 If the patient is admitted to the hospital, his/her visitors are restricted to non-pregnant persons. Visitors should avoid close contact with the patient.

3.6.4 The patient will be provided with instructions regarding additional precautions to keep exposures to others ALARA.

3.7 RADIATION MONITORING EQUIPMENT

3.7.1 An ionization chamber (Ludlum Model 2241-3) will be used to monitor radiation exposure during dose delivery and to monitor patient exposure at one meter prior to patient release.

3.7.2 A directional beta detector (Ludlum Model 44-1) may be used to monitor the source vial and lines during delivery.

3.7.3 A pancake GM or suitable detector (Ludlum Model 44-1) will be used for monitoring all equipment and personnel for contamination.

3.8 MEDICAL EVENT

A medical event will be reported as required, except for an event that results from intervention of a patient, in which:

3.8.1 The administration of byproduct material results in a dose that exceeds 0.05 Sv (5 rem) effective dose equivalent or 0.5 Sv (50 rem) to an organ or tissue from the use of the **wrong radionuclide**; or

3.8.2 the administration of Y-90 microspheres results in a dose that differs from the prescribed dose or the dose that would have resulted from the prescribed activity, as documented in the written directive, by more than 0.05 Sv (5 rem) effective dose equivalent or 0.5 Sv (50 rem) to an organ or tissue, and the total dose/activity administered differs from the prescribed dose/activity, as documented in the written directive, by **20 percent or more**; or

3.8.3 the administration of Y-90 microspheres results in a dose that exceeds 0.05 Sv (5 rem) effective dose equivalent or 0.5 Sv (50 rem) to an organ or tissue from an administration to the **wrong individual**, via the **wrong route**, or by the **wrong mode of treatment**; or

3.8.4 the administration of Y-90 microspheres results in a dose to an **organ or tissue other than the treatment site** that exceeds by 0.5 Sv (50 rem) to an organ or tissue and by 50 percent or more of the prescribed dose/activity expected to that site from the administration of Y-90 microspheres, if carried out as specified in the written directive.

3.9 EMERGENCY PROCEDURES

If the patient dies or undergoes a medical emergency following the dose delivery, the referring physician will be notified immediately. The Radiation Safety Officer will also be notified immediately.

4.0 RECORDS AND REPORTS

4.1 RECORDS

Radiation safety records associated with the delivery of the Y-90 microspheres include (but are not limited to) records related to ordering, package receipts, training, written directives, dose assay and delivery, personnel monitoring results, area surveys, and spills. All applicable radiation safety records will be maintained according to NRC regulations.

4.2 REPORTS

Certain reports are required if a Y-90 microsphere treatment results in a spill, recordable event, or medical event. In all instances, the Radiation Safety Officer will be notified immediately and will take appropriate actions.

SUBJECT: SIR-Spheres Dose Measurement Procedure

1.0 PURPOSE

This procedure provides instructions and guidance to ensure accuracy of Yttrium-90 (Y-90) SIR-Spheres patient dose measurements.

2.0 SCOPE

This procedure applies to all Y-90 microsphere therapies performed at The Queen's Medical Center (QMC). This procedure is also supplemented by current Radiation Safety policies and procedures as applicable: "Radiopharmaceutical Therapy Procedures", "Radiopharmaceutical Quality Management Program", "Safe Use of Radiopharmaceuticals", "Radiopharmaceutical Spill Procedures", and "Radioactive Waste Disposal".

3.0 PROCEDURE

3.1 SIR-Spheres Dose Assay

According to the manufacturer's instruction, a dial setting of 775 with a multiplication factor of 70, or a dial setting of 48 with multiplication factor of 10 will give consistent readings for yttrium-90 sources between 1Gbq and 3Gbq over a range of volumes. These settings will be used initially and adjusted if necessary as a result of calibration activities.

Yttruim-90 SIR-Spheres will be measured in the appropriate Capintec dose calibrator and assigned dial settings. The SIR-Spheres activity measurements will be compared (allowing for decay) to the manufacturer-supplied measurement on the vial label. Any discrepancy greater than 10% will be resolved before continuing.

3.2 Dose Calibrator Calibration

According to the manufacturer, the manufacturer calibrates its dose calibrators with secondary national standards. The manufacturer's dose calibrator measurement at time and date of SIR=Spheres manufacture is supplied with the first few, generally three (3) devices.

The calibration of the Capintec dose calibrator will utilize the manufacturer-supplied measurement on the vial label of the SIR-Spheres device. Adjustments to the dose calibrator settings should be made to bring the measurement of the Capintec dose calibrator to within ±10% of the manufacturer-supplied measurement.

At regular intervals verify the accuracy of the dose calibrator yttrium-90 setting.

Potential areas of inaccuracy are:

1. The activity measured
2. The volume of the source
3. The shape of the container holding the source
4. The material of the container holding the source
5. Homogeneity of the suspension

4.0 RECORDS AND REPORTS

4.1 RECORDS

Radiation safety records applicable to the dose calibrator calibration for Y-90 SIR-Spheres will be maintained according to NRC regulations.

4.2 REPORTS

Certain reports are required if a Y-90 microsphere treatment results in a spill, recordable event, or medical event. In all instances, the Radiation Safety Officer will be notified immediately and will take appropriate actions.

Radiation Safety equipment
for
Y-90 SIR-Spheres

INSTRUCTION MANUAL

LUDLUM MODEL 2241-3 & 2241-3i
SURVEY METER

July 2007

Serial Number 238342 and Succeeding

Serial Numbers

#1 BETA DETECTOR

#2 GAMMA DETECTOR

LUDLUM MEASUREMENTS, INC.
P.O. Box 810 / 501 Oak Street
SWEETWATER, TEXAS 79556
Phone: 800-622-0828(USA), 325-235-5494 Fax: 325-235-4672
www.ludlums.com

SIN: 267152

#1

INSTRUCTION MANUAL

LUDLUM MODEL 44-1
BETA SURVEY DETECTOR

Serial Number PR134493
and Succeeding Serial Numbers
Revised April 1997

LUDLUM MEASUREMENTS, INC.
P.O. Box 810 / 501 Oak Street
SWEETWATER, TEXAS 79556
Phone: 800-622-0828(USA), 325-235-5494 Fax: 325-235-4672
www.ludlums.com

S/N: PR278617

#2

INSTRUCTION MANUAL

LUDLUM MODEL 44-62
GAMMA SCINTILLATOR

August 2008
Serial Number PR138489 and Succeeding Serial Numbers

LUDLUM MEASUREMENTS, INC.
P.O. Box 810 / 501 Oak Street
SWEETWATER, TEXAS 79556
Phone: 800-622-0828(USA), 325-235-5494 Fax: 325-235-4672
www.ludlums.com

S/N: PR284635

THE QUEEN'S MEDICAL CENTER
NUCLEAR MEDICINE DEPARTMENT

RADIOPHARMACEUTICAL QUALITY MANAGEMENT PROGRAM

I. Dosage Procedures

The following procedures shall only apply to these specific radiopharmaceuticals:

a. Sodium Iodide-125 > 30 microcuries (uCi)
b. Sodium Iodide-131 > 30 microcuries (uCi)
c. All Phosphorus-32 Therapy Doses
d. All Strontium-89 Therapy Doses
e. All Samarium-153 Therapy Doses
f. All Yittrium-90 Therapy Doses
g. All Bexxar I-131 Therapy Doses

1. Before administering one of the above dosages, an Authorized User shall date and sign a Written Directive.

   a. An oral revision to the written directive is acceptable if, because of the patient's condition, a delay in order to provide a written revision to an existing written directive would jeopardize the patient's health. Oral revisions must be documented immediately in the patient's record, and a revised written directive must be signed and dated by an authorized user or physician under the supervision of an authorized user within 48 hours of the oral revision.

   b. If, because of the emergent nature of the patient's condition, a delay in order to provide a written directive would jeopardize the patient's health, and oral directive will be acceptable provided that the information provided in the oral directive is documented immediately in the patient's record and a written directive is prepared within 24 hours of the oral directive.

   c. Revisions to written directives may be made for any diagnostic or therapeutic procedure provided that the revision is dated and signed by an authorized user prior to the administration of the radiopharmaceutical dosage.

2. For administration of I-131 as Sodium Iodide greater than 30 uCi the Written Directive shall specify:

   a. Patients Name;
   b. Dosage of I-131 as Sodium Iodide.

3. For therapeutic dosage of unsealed byproduct material other than I-131 the Written Directive shall specify:

   a. Patients Name;
   b. Radioactive Drug;
   c. Dosage;
   d. Route of Administration.

4. For doses other than I-131, the predraw dose assay shall be compared with the calibrated activity on the vial label and taking into account the radiation decay factor. Any discrepancy greater than 10% shall be resolved before continuing.

5. Before administering the dosage, the dosage shall be measured in the dose calibrator and the results compared with the prescribed dosage in the Written Directive. Any discrepancy greater than 10% shall be confirmed with the AU before continuing.

6. The radiopharmaceutical, administered dose, and route of administration must be verified by the individual administering the radiopharmaceutical to the patient for agreement with the written directive.

7. Before administering the dosage, the identity of the patient shall be verified as the individual named in the Written Directive by more than on method. The procedure to identify the patient shall be to ask the patient's name and confirm the name and at least one of the following by comparison with corresponding information in the patient's record: birth date, address, social security number, signature, the name on the patient's identification bracelet or hospital identification card, or the name on the patient's medical insurance card.

8. Before administering the dosage, the Technologists shall be required to seek guidance if they do not understand the Written Directive. Any question regarding what to do or how to do it shall be answered before continuing.

9. After administering the dosage, the Authorized User or Technologist shall make a dated signed Written Record of the Administered dosage.

10. The Written Directive and Written Record shall be retained for three years.

II. Recordable Events

1. A Recordable Event means an administration of dosage when one or more of the following conditions occur:

   a. No Written Directive;
   b. No Written Record;
   c. Administered Dosage differs from the Written Directive by more than 10% and more than 15 microcuries.

2. A Recordable Event shall be investigated and documented within 30 days. A Written Report shall include the relevant facts, the cause of the event, and what corrective action, if any, is required to prevent recurrence.

3. The record shall be retained for three years.

THE QUEEN'S MEDICAL CENTER
NUCLEAR MEDICINE DEPARTMENT

RADIOPHARMACEUTICAL QUALITY MANAGEMENT PROGRAM

III. Misadministrations

1. A Misadministration means an administration of dosage when one or more of the following conditions occur:

   a. Wrong patient;
   b. Wrong radiopharmaceutical;
   c. Wrong route of administration;
   d. Administered Dosage differs from Written Directive by more than 20% and more than 30 microcuries.

   In addition to the Sodium Iodide and Phosphorus-32 cases, a Misadministration shall include all diagnostic doses other than sodium iodide > 30 microcuries when the above conditions are met and the dose to patient exceeds 5 rem effective dose equivalent or 50 rems dose equivalent to any individual organ.

2. The NRC Operations Center shall be notified by telephone no later than the next calendar day after discovery of the misadministration.

3. The referring physician shall be notified no later than 2 hours after the discovery of the misadministration.

4. The patient shall be notified no later than 24 hours after the discovery of the misadministration unless the referring physician personally informs the licensee that either he will inform the patient or that telling the patient would be harmful.

5. The Written Report shall be submitted to NRC Region IV Office within 15 days after discovery of the misadministration.

6. If the patient was notified, the licensee shall also furnish, within 15 days after discovery of the misadministration, a written report to the patient by sending a copy of the report that was submitted to the NRC.

7. The Written Report shall include:
   the licensee's name (but not the patient's name)
   the prescribing physician's name
   a brief description of the event
   why the event occurred
   the effect on the patient
   what improvements are needed to prevent recurrence
   actions taken to prevent recurrence
   whether the licensee notified the patient
   if patient not notified, then why not
   if the patient was notified, then what was said

8. A record of the Misadministration shall be retained for five years. The record shall include the Written Report as well as the:
   patient's name
   patient's social security number
   referring physician's name
   prescribing physician's name
   technologist's name

IV. Periodic Review

1. The records of the Program shall be reviewed quarterly. This Review shall include:

   All Written Directives – complete and correct
   All Written Records – agreement with Written Directive
   All Recordable Events – complete and accurate
   All Misadministrations – complete and accurate

2. The Review will identify cases of deviation from the Written Directive, the cause of each deviation, and the action required to prevent recurrence.

3. All Recordable Events and Misadministrations will be presented at the Quarterly Radiation Safety Committee meeting.

4. The Quality Management Program will be reviewed annually as part of the annual Management Audit and presented to the Radiation Safety Committee. The Program will be reevaluated for its effectiveness at that time.

5. Records of the Review shall be retained for three years.

6. Modifications to the Quality Management Program will be submitted to the NRC within 30 days after the modification has been made as required by 10 CFR 35.32(e).

V. Training

1. Training on the QMP will be provided to all supervised individuals who participate in patient care and treatment.

2. This training shall be conducted by the licensee once in each calendar year.

THE QUEEN'S MEDICAL CENTER
RADIOPHARMACEUTICAL THERAPY PROCEDURES

BETA RADIOPHARMACEUTICAL

P-32, a high-energy pure beta emitter, is routinely administered directly into the peritoneal cavity of some cancer patients. The radiation exposure hazard is minimal because most of the P-32 beta particles cannot escape the patient's body once administered.

Contamination is the primary concern with these patients as it is possible for the treatment site to leak. The following precautions for radiation safety should be observed:

1. Use universal hospital safety precautions.
2. Provide all necessary care, but:
    a. Try to minimize time spent with patient,
    b. Work no closer to patient than necessary,
    c. Wear gloves while attending patient.
3. Visitors under 18 and pregnant visitors are not permitted in patient's room.
4. Save dressings in a trash bag designated for dressings only.
5. Radiation Safety will pick up dressings daily.
6. Notify the Radiation Safety Officer (RSO) if:
    a. The treatment site begins to leak,
    b. You suspect contamination outside the treatment area,
    c. There is a medical emergency (including death).
7. Radiation Safety will assist the nursing staff to determine whether the treatment site is or is not leaking. If the treatment site is leaking, contaminated items will be decontaminated or picked up for decay-in-storage.
8. When patient catheter, tubing, etc. is removed place in separate bag and call Radiation Safety for pick-up.
9. No room items are to be removed without clearance from Radiation Safety.
10. All trash and linen must be surveyed by Radiation Safety before disposal.
11. Radiation Safety will survey trash and linen daily.

RADIATON SAFETY

Gary Sonan, Radiation Safety Technician.....Office x7706 / Pager 578-8299

Brian Oyadomari, Radiation Safety Officer.....Office x4884 / Pager 578-8209

THE QUEEN'S MEDICAL CENTER
RADIOPHARMACEUTICAL THERAPY PROCEDURES

I-131 THERAPY TREATMENT

1. The patient's room will be as far away from the nursing station and heavy traffic hallways as is consistent with good medical care. It will be a private room with private sanitary facilities and should be without carpet.

2. Prepare the room for procedure as follows:

   a. Use leak-proof absorbent paper to cover large surfaces (counter, patient table, the floor in front of the sink, and the floor around the toilet) that are likely to be contaminated. Small items (telephone, door handles, bed control, television control, faucet handles, and light switches) may be covered with plastic wrap.

   b. Prepare linen hamper and place in patient's room.

   c. Place lead shields around patients bed. Small or medium shield at the side of the bed for nurse's protection, medium shield at the foot of the bed to shield adjacent room, and large shield at the head of the bed to shield adjacent room if necessary.

3. Patient excreta will be disposed by release to the sanitary sewer. Patients will be advised to sit while using the toilet and flush three times after each use.

4. Order disposable table service for the duration of the patient's stay. Inform the Housekeeping Office that personnel should stay out of the room until otherwise notified.

5. Brief the nurses on radiation safety precautions. Allow time for questions and answers during the briefing. Leave a written copy of the radiation safety precautions in the patient's chart, at the nursing station, or at the patient's door.

6. Brief the patient on radiation safety procedures for the dosage administration, visitor control, radioactive waste, and other items as applicable.

7. Only those persons needed for medical, safety, or training purposes should be present during administration.

8. Advise the patient and nurses that guests must maintain a distance of six feet from patient while visiting.

9. Following administration of the dosage, measure the exposure rate in mR/hr. at beside, at one meter from the patient, at two meters from the patient, and in the surrounding hallways and rooms. Record data in the patient's chart and post exposure rates on the patient's doorway.

10. Post the room with a "Radioactive Materials" sign.

11. The exposure rate for surrounding unrestricted areas are to meet the both of the following conditions:

    a. Less than 2 millirem in any one hour, and

    b. Less than 100 millirem in any seven consecutive days.

12. As the therapy proceeds, pick up waste and transfer to the decay-in-storage area in the Queen Emma Tower 1 Radiation Waste Storage Room.

13. Do not release any patient until either the exposure rate from the patient is less than 5 millirem per hour at 1 meter or the retained radioactivity is less than 30 millicuries. If you use the exposure rate standard as the release criterion, measure it with a radiation measurement survey meter at a distance of 1 meter from the umbilicus while the patient is standing, or, if the patient is not ambulatory, one meter from the bedside with the patient supine.

    Calculate the current activity by:

    Current Activity = (Current mR/hr @ One Meter x Initial Activity) / (Initial mR/hr @ One Meter)

14. Before using the room for general occupancy, it must be decontaminated and released to the Bed Control.

    a. Remove all absorbent paper, and place it in the appropriate container.

    b. Transfer al containers to a decay-in-storage or decontamination area.

    c. Use a radiation detection survey meter to check for room contamination. Clean contaminated areas until removable contamination is less than 200 dpm/100 cm^2.

15. After room has been decontaminated and "Radioactive Materials" signs removed from door, notify the Nursing Station that the room is cleared of all radiation safety precautions and restrictions.

16. **Patient care must not be compromised because of potential radiation exposure.** In the event of a medical emergency follow hospital guidelines and contact the RSO and Nuclear Medicine Physician STAT (Emergency contacts are listed in patients' chart).

17. In the event of urine, emesis, or any bodily fluid spills, or patient death, contact the RSO and Nuclear Medicine Physician STAT (Emergency contacts are listed in patients' chart).

THE QUEEN'S MEDICAL CENTER
RADIATION SAFETY PROGRAM

SUBJECT: RADIOACTIVE SPILLS

1. PURPOSE

1.1 To establish clearly delineated thresholds for describing these types of events.

1.2 To establish a graded response to emergencies, incorporating increasing formality of a response based on the potential risks posed by the events.

2. SCOPE

2.1 No emergency procedure can anticipate every likely event, therefore, flexibility and judgment must be incorporated into such procedures.

2.2 Most importantly, if staff members are not sure of the proper or expected response to any event, no matter how minor, they must immediately cease further action, control access to the area, contact the Radiation Safety Officer (RSO), and wait for instructions.

3. MINOR CONTAMINATON EVENTS

3.1 Minor contamination events are those events typically identified through routine surveys that involve removable contamination levels greater than the action limit, but less than ten times the action limit.

3.2 Minor contamination events can be easily decontaminated without the need for strict adherence to a step-by-step procedure.

3.3 Minor contamination events require judgment on the part of the individuals responding to determine the scope and extent of the contamination and to assess their ability to respond effectively.

3.4 In order to prevent the spread of contamination, coworkers should be notified if decontamination of the area will be delayed.

3.5 The RSO must be notified promptly of such events, either before, or immediately after, cleanup of the area.

3.6 Isolated minor contamination events may not require a formal root cause evaluation or extensive corrective action determinations; however, several events in the same location, involving the same individual, or during similar processes, may warrant such in-depth evaluations and determinations.

4. MINOR SPILLS OF LIQIUDS AND SOLIDS

4.1 Notify persons in the area that a spill has occurred.

4.2 Prevent the spread of contamination by covering the spill with absorbent paper.

4.3 Survey all personnel present in the immediate area for contamination.

4.4 Wear gloves and protective clothing such as a lab coat and booties, and clean up the spill using a radiodecontamination cleaner and absorbent paper.

4.5 Carefully fold the absorbent with the clean side out and place in a bag.

4.6 Place the contaminated glove and any other contaminated disposable material in the bag.

4.7 Write the following information on the bag:

Name
Date
Radioisotopes involved
Activity

4.8 Transfer the bag to the Radioactive Waste Storage Room.

4.9 Survey the area with a low-range radiation detection survey instrument sufficiently sensitive to detect the radionuclide.

4.10 Check for removable contamination to ensure contamination levels are below trigger levels.

4.11 Check the area around the spill. Also check hands, clothing, and shoes for contamination.

4.12 Complete the Radioactive Spill Report.

4.13 Report the incident to the RSO.

5. MAJOR SPILLS OF LIQUIDS AND SOLIDS

5.1 Clear the area. If appropriate, survey all persons not involved in the spill and vacate the room.

5.2 Prevent the spread of contamination by covering the spill with absorbent paper (paper should be dampened if solids are spilled), but do not attempt to clean it up.

5.3 To prevent the spread of contamination, limit the movement of all personnel who may be contaminated.

5.4 Shield the source only if it can be done without further contamination or significant increase in radiation exposure.

5.5 Close the room and secure the area to prevent entry. Post a sign to warn anyone trying to enter that a spill of radioactive material has occurred.

5.6 Notify the RSO immediately.

5.7 Survey all personnel who could possibly have been contaminated. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin for a minimum of 5 minutes with lukewarm water and then washing with a mild soap.

5.8 Remain in the area to provide information.

5.9 Allow no one to return to work in the area unless approved by the RSO.

5.10 Follow the instructions of the RSO (e.g., decontamination techniques, surveys, provision of bioassay samples, requested documentation).

6. GUIDELINES FOR PERSONAL CONTAMINATION

6.1 Radioactive contamination should be removed from the skin as soon as possible to reduce radiation exposure.

6.2 Contamination deposited directly on the skin can cause intense irradiation of the skin as well as substantially increasing the risk for intake into the body.

6.3 Gloves should be worn to prevent the spread of radioactive contamination to the hands during decontamination operations.

6.4 Use mild hand soap or other appropriate solution for use on the skin. Some decontamination solutions and cleansers contain harsh chemicals and are not intended for use on the skin.

6.5 Water used for skin decontamination should be lukewarm in temperature. Water that is too hot or too cold will increase the blood flow to the area and increase the absorption of the contamination.

6.6 Gently wash or scrub the affected skin areas for about 2 to 3 minutes. Pay special attention to the fingernails if the hands are contaminated

6.7 Rinse with clean water and gently pat dry. Re-monitor the area with a contamination monitor.

6.8 Repeat this procedure as necessary, RUB DO NOT SCRUB.

6.9 Work from the center of your body out (if your forearm is contaminated wash from the elbow towards the hand, hold your arm such that the water runs off your arm into the sink, not onto the floor or your body).

6.10 Monitor affected skin areas after every decontamination; attempt to determine effectiveness.

6.11 Stop cleaning immediately if contamination cannot be removed, or if the skin becomes irritated.

6.12 Rinse your eyes in an eyewash station for at least 15 minutes to flush foreign material out.

6.13 Rinse your mouth with water, but DO NOT swallow.

6.14 Blow your nose and keep the tissue, it will be analyzed for radioactive contamination. The nose filters approximately 50% of particulate matter.

6.15 Have someone absorb surface liquids, and liquids in the outer ear, lean to the side which has the liquid in it. Do not stick anything in your ear.

7. GUIDELINES FOR CONTAMINATED CLOTHING

7.1 Put on and wear a clean pair of gloves to carefully remove all contaminated clothing in such a way as to prevent a further spread of contamination, especially to the skin.

7.2 Remove clothing inside out to contain the contamination.

7.3 Seal the contaminated clothing in a plastic bag.

7.4 Write the following information on the bag:

Name
Date
Radioisotopes involved
Activity

7.5 After removal of contaminated clothing, carefully monitor all exposed skin areas. Monitor your hands. Follow the guidelines for personal contamination if any contamination is detected.

7.8 Transfer clothing to the Radioactive Waste Storage Room. The clothing will most likely be stored until the radioactivity has decayed.

8. PROCEDURES FOR DECONTAMINATION OF EQUIPMENT AND AREAS

8.1 Tools, equipment, and work areas must be free of radioactive contamination whenever possible.

8.2 All users are responsible for conducting surveys and promptly decontaminating all items and surfaces, if required.

8.3 Always wear protective clothing during decontamination operations.

8.4 Wear gloves and protective clothing such as a lab coat and booties, and clean using a radiodecontamination cleaner and absorbent paper.

8.5 Methods used in decontamination include washing, scrubbing, abrasion, and corrosive methods.

8.6 Always start with washing before progressing to more difficult decontamination methods.

8.7 DO NOT use methods such as grinding, sanding, scraping or chipping contaminated surfaces without the specific direction from the RSO.

8.8 Complex items should be disassembled as much as possible to allow sufficient cleaning of inner surfaces which may be contaminated. Do not disassemble if such action will jeopardize the operational integrity of the item or equipment.

8.9 Use disposable materials, such as paper towels.

8.10 Minimize the spread of contamination during decontamination operations. Avoid wiping a highly contaminated cleaning towel over a less contaminated surface. Generally, the best technique is to start at the edge of a contaminated area and work toward the area of highest contamination.

8.11 The exception to this, however, would be to clean highly contaminated areas first if those areas were creating unacceptably high radiation exposure levels.

8.12 Frequently monitor surfaces during decontamination with either portable survey instruments or swipe tests to determine the effectiveness of the procedures being used.

8.13 Continue decontamination as necessary.

8.14 Conduct SWIPE TESTS to confirm that there is no removable contamination.

8.15 Items and surfaces which cannot be successfully decontaminated must be identified and controlled as radioactive material. Such areas may also require shielding.

8.16 Ensure that all radioactive waste generated during decontamination is properly collected and disposed into the solid and liquid waste containers.

8.17 Once decontamination procedures are complete, remove gloves and wash hands thoroughly.

8.18 Monitor hands, body, lab coat, clothing, etc., for radioactive contamination.

Waste Disposal Program

A. Disposal by Decay-In-Storage (DIS)

Radioactive materials with a physical half-life less than 65 days may be disposed by Decay-In-Storage (DIS).

1. Store the Tc-99m waste separate from the other longer lived material. Because the waste needs to be surveyed without shielding to quantify the radioactivity, the containers in which waste will be disposed must not provide any radiation shielding.
2. Before storing radioactive waste containers or bags in the shielded DIS bins, properly seal all containers and bags with tape or string.
3. Each waste container or bag must have an identification tag or be properly labeled with the following information: the date sealed, the longest-lived radioisotope in the container, and the initials of the person sealing the container.
4. All radioactive waste will be decayed for at least 10 half-lives.
5. Twice each week, the radioactive storage bins will be monitored for ambient radiation level compliance (10CFR 20.1501, 20.1201) and removal of all completely decayed waste.
6. Once each week, the radioactive storage bins will be monitored for removable surface contamination in accordance to 10CFR 20.1501.
7. Prior to disposal as in-house waste, survey and record the results of each container as follows:
   a. Check your radiation detection survey meter for proper operation.
   b. Monitor in a low-level (less than 0.05 mR/hr) radiation area
   c. Remove any shielding from around the container or generator column.
   d. Monitor, at contact, all surfaces of each individual container
   e. Discard as in-house waste only those containers that cannot be distinguished from background. Remove or deface any radioactive material labels.
   f. Record the disposal date, the survey instrument used, the background dose rate, the highest dose rate measured at the surface of each container, and the name of the individual who performed the disposal.
   g. Containers that can be distinguished from background radiation levels must be returned to the storage bins for further decay.

Reviewed by: Brian Oyadomari, MS, DABR

Radiation Safety Officer

Enclosed: #2

SIRTEX MEDICAL INC.
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Wilmington, MA 01887 USA

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Website: www.sirtex.com

MEMORANDUM

TO: **ALL SIR-Spheres microspheres Users, RSO's**
FROM: Linda Teigland
DATE: August 12, 2010
SUBJECT: License Amending Information

In order to use our product, you will need to amend your Radioactive Materials License which will require the following information:

Issuer: The Commonwealth of Massachusetts, Radiation Control program

License No: MA-1229-D-101-S

Distributor: Sirtex Wilmington LLC
16 Upton Drive,, #2-4 Wilmington, MA 01887

Sealed Source Model Designation: Sirtex Medical Limited SIR-Spheres® microspheres

Isotope: Yttrium-90

Maximum Activity: 7 GBq (189 mCi) per vial

Sirtex Medical Limited
Level 33, 101 Miller Street, North Sydney NSW 2060
Australia
Tel: +61 2 9964 8400

Sirtex Medical Inc
Unit 2-4, 16 Upton Drive, Wilmington MA 01887
USA
Telephone: 1 888 474 7839

SIRTeX

SIR-Spheres® microspheres
(Yttrium-90 Microspheres)

1. DESCRIPTION

SIR-Spheres microspheres consist of biocompatible microspheres containing yttrium-90 with a size between 20 and 60 microns in diameter. Yttrium-90 is a high-energy pure beta-emitting isotope with no primary gamma emission. The maximum energy of the beta particles is 2.27MeV with a mean of 0.93MeV. The maximum range of emissions in tissue is 11mm with a mean of 2.5mm. The half-life is 64.1 hours. In therapeutic use, requiring the isotope to decay to infinity, 94% of the radiation is delivered in 11 days. The average number of particles implanted is $30 - 60 \times 10^6$. SIR-Spheres microspheres are a permanent implant.

SIR-Spheres microspheres are implanted into a hepatic tumor by injection into either the common hepatic artery or the right or left hepatic artery via the chemotherapy catheter port. The SIR-Spheres microspheres distribute non-uniformly in the liver, primarily due to the unique physiological characteristics of the hepatic arterial flow, the tumor to normal liver ratio of the tissue vascularity, and the size of the tumor. The tumor usually gets higher density per unit distribution of SIR-Spheres microspheres than the normal liver. The density of SIR-Spheres microspheres in the tumor can be as high as 5 to 6 times of the normal liver tissue. Once SIR-Spheres microspheres are implanted into the liver, they are not metabolized or excreted and they stay permanently in the liver. Each device is for single patient use.

2. INDICATIONS FOR USE

SIR-Spheres microspheres are indicated for the treatment of unresectable metastatic liver tumors from primary colorectal cancer with adjuvant intra-hepatic artery chemotherapy (IHAC) of FUDR (Floxuridine).

3. CONTRAINDICATIONS

SIR-Spheres microspheres are contraindicated in patients who have:

- had previous external beam radiation therapy to the liver;
- ascites or are in clinical liver failure;
- markedly abnormal synthetic and excretory liver function tests (LFTs);
- greater than 20% lung shunting of the hepatic artery blood flow determined by Technetium MAA scan;
- pre-assessment angiogram that demonstrates abnormal vascular anatomy that would result in significant reflux of hepatic arterial blood to the stomach, pancreas or bowel;
- disseminated extra-hepatic malignant disease;
- been treated with capecitabine within the two previous months, or who will be treated with capecitabine at any time following treatment with SIR-Spheres microspheres;
- portal vein thrombosis.

4. WARNINGS

- Inadvertent delivery of SIR-Spheres microspheres to the gastrointestinal tract or pancreas will cause acute abdominal pain, acute pancreatitis or peptic ulceration.
- High levels of implanted radiation and/or excessive shunting to the lung may lead to radiation pneumonitis.
- Excessive radiation to the normal liver parenchyma may result in radiation hepatitis.
- Inadvertent delivery of SIR-Spheres microspheres to the gall bladder may result in cholecystitis.

5. PRECAUTIONS

- No studies have been done on the safety and effectiveness of this device in pregnant women, nursing mothers or children.
- Due to the radioactivity of this device and the significant consequences of misplacing the microspheres in situ, this product must be implanted by doctors with adequate training in the handling and implantation technique for this device.
- Sirtex recommends a SPECT scan of the upper abdomen be performed immediately after implantation of SIR-Spheres microspheres. The SPECT scan will detect the Bremsstrahlung radiation from the yttrium-90 to confirm placement of the microspheres in the liver.
- This product is radioactive. The use of this device is regulated under Title 10 of the Code of Federal Regulations Part 35. These regulations must be followed when handling this device.
- All persons handling, dispensing and implanting this device must be familiar with and abide by all Local, State and Federal regulatory requirements governing therapeutic radioactive materials. Accepted radiation protection techniques should be used to protect staff when handling both the isotope and the patient.
- Some patients may experience gastric problems following treatment but H-2 blocking agents may be used the day before implantation of SIR-Spheres microspheres and continued as needed to reduce gastric complications.
- Many patients may experience abdominal pain immediately after administration of SIR-Spheres microspheres and pain relief may be required.
- SIR-Spheres microspheres demonstrated a mild sensitization potential when tested dermally in an animal model.

6. CLINICAL TRIAL RESULTS

In a randomized, controlled clinical trial, a total of 70 patients were studied in two arms, 34 patients with FUDR chemotherapy (control group), and 36 patients with FUDR plus SIR-Spheres microspheres. The results are shown in the following tables.

Table 1 – Tumor Response by Volume

Response	CR	PR	NC	PD	Others
FUDR only (N = 34)	1	7	12	9	5
FUDR + SIR-Spheres microspheres (N = 36)*	2	16	10	5	3

* (P=0.033)

Tumor response was measured by two consecutive CT scans in a 3-month interval period.

CR = Complete Response, PR = Partial Response,
NC = No Change, PD = Progressive Disease,
Others = No follow up, or unmeasurable

Table 1 indicates that there is a statistically significant improvement of the tumor response rates (CR+PR) in the group treated with FUDR plus SIR-Spheres microspheres, when compared with the group treated with FUDR only.

Table 2 – Time to First Progressive Disease in the Liver

	FUDR Only	FUDR + SIR-Spheres microspheres
Number of Patients	34	36
Mean Time in Days +/- SD*	312 Days +/- 330	510 Days +/- 516
Median Time in Days*	233 Days	366 Days

*(P=0.05)

Progressive Disease was defined as more than 25 % increase of tumor volume, or development of new lesion(s) in the follow up CT scan, when compared to the pre-treatment CT scan.

Table 2 indicates that there is a statistically significant delay of time to progression of the disease in the group treated with FUDR plus SIR-Spheres microspheres, when compared with the group treated with FUDR only.

7. ADVERSE EVENTS

When the patient is treated with proper technique, without excessive radiation to any organ, the common adverse events after receiving the SIR-Spheres microspheres are fever, transient decrease of hemoglobin, mild to moderate abnormality of liver function tests (mild increase in SGOT, alkaline phosphatase, bilirubin), abdominal pain, nausea, vomiting, and diarrhea.

In the phase III randomized controlled clinical trial with 70 patients, there was a minimal increase of Grade 1 and 2 events, mostly transient abnormal LFTs and nausea and vomiting in the patients who received SIR-Spheres microspheres. There was no difference in the number of patients who developed Grade 3 and 4 adverse events between the two groups. No patient died due to the adverse events directly related to SIR-Spheres microspheres.

Table 3 – Adverse Events

	Grade 1 and 2		Grade 3 and 4	
Events	**FUDR**	**FUDR + SIR-Spheres microspheres**	**FUDR**	**FUDR + SIR-Spheres microspheres**
Hemoglobin	4	5	1	0
Bilirubin	7	2	0	1
AST (SGOT)	110	109	14	7
Alk. Phos.	90	188	5	14
Nausea/ Vomiting	5	13	2	1
Diarrhea	6	3	1	0
Total	**222**	**320**	**23**	**23**

The data are from a clinical trial with 34 patients on chemotherapy only, and 36 patients on chemotherapy plus SIR-Spheres microspheres.

Potential Serious Adverse Events Due to High Radiation

- **Acute pancreatitis** ---- causes immediate severe abdominal pain. Verify by SPECT imaging of the abdomen (Yttrium-90 Bremsstrahlung image) and test for serum amylase.
- **Radiation Pneumonitis** ---- causes excessive nonproductive cough. Verify by X-ray evidence of pneumonitis.
- **Acute Gastritis** ---- causes abdominal pain. Verify by standard methods to diagnosis gastric ulceration.
- **Radiation Hepatitis** ---- causes unexplained progressive deterioration of liver function. Verify by transcutaneous core biopsy of the liver.
- **Acute cholecystitis** ---- causes significant upper abdominal pain and may require cholecystectomy for resolution. Verify by appropriate imaging studies.

8. PATIENT SELECTION AND PRE-TREATMENT TESTING

- Patients are indicated for treatment with SIR-Spheres microspheres when the metastatic colorectal cancer in the liver is considered non-resectable. In any of the following circumstances, patients would generally be considered non-resectable:
  1. multiple liver metastases together with involvement of both lobes;
  2. tumor invasion of the hepatic confluence where the three hepatic veins enter the IVC such that none of the hepatic veins could be preserved if the metastases were resected;
  3. tumor invasion of the porta hepatis such that neither origin of the right or left portal veins could be preserved if resection were undertaken; and
  4. widespread metastases such that resection would require removal of more liver than is necessary to maintain life.
- Resectability may be evaluated via imaging with a triple phase contrast angio-portal CAT scan or MRI.

Patient Tests Before Treatment with SIR-Spheres microspheres

The following tests are recommended before treatment:

- A hepatic angiogram should be performed to establish arterial anatomy of the liver.
- A nuclear medicine break-through scan (Intrahepatic Technetium MAA Scan) to determine the percent lung shunting. If a port has been inserted, this test can be performed through the port.
- Serologic tests of liver function should be performed to determine the extent of liver function damage.

Appropriate imaging studies are recommended to determine the extent of disease. These may include chest x-ray, CT scan of chest and abdomen, abdominal ultrasound and a bone scan.

9. RADIATION SAFETY

The preparation and implant procedure must be regarded as being a potentially serious radiation hazard to the staff and a serious contamination hazard. Regulatory and local radiation usage guidelines should be followed concerning implantation and post-implantation care.

The following are sample measured thermoluminescent dosimetry (TLD) exposures to personnel.

Table 4 – Exposure Dose Per Patient for Implant Preparation (Technologist)

	Trunk mSv (mrem)	Lens of the Eye mSv (mrem)	Hands mSv (mrem)
Shallow Dose (0.07mm)	0.027 (2.7)	0.026 (2.6)	0.35 (35)
Deep Dose (10 mm)	0.003 (0.3)	0.004 (0.4)	

Assuming handling of a 3 GBq device and dose preparation time of 30 minutes. TLDs were worn near the pelvis, on the shirt's lapel, and on the working finger.

Table 5 – Exposure Dose Per Patient for Implant Procedure (Physician)

	Trunk mSv (mrem)	Lens of the Eye mSv (mrem)	Hands mSv (mrem)
Shallow Dose (0.07mm)	0.038 (3.8)	0.12 (12)	0.32 (32)
Deep Dose (10 mm)	0.004 (0.4)	0.054 (5.4)	

Assuming average patient dose of approximately 2 GBq and dose injection time of 20 minutes.

® SIR-Spheres is a Registered Trademark of Sirtex SIR-Spheres Pty Ltd

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Post-Implant Exposure

Exposure data from patients implanted with an average of 2.1GBq at approximately 5-6 hours post implantation at the following distances from the patient's abdomen:

0.25m	18.8 µSv/hr
0.5m	9.2 µSv/hr
1m	1.5 µSv/hr
2m	0.4 µSv/hr
4m	<0.1 µSv/hr

(1mSv = 100 mrem)

10. HOW SUPPLIED

SIR-Spheres microspheres are provided in a vial with water for injection. Each vial contains 3GBq of yttrium-90 (at the time of calibration) in a total of 5 cc water for injection. Each vial contains 40 - 80 million microspheres. The vial is shipped within a 6.4mm thick, lead pot. The package consists of a crimp-sealed SIR-Spheres microspheres glass vial within a lead pot, and a package insert within Type A packing bucket.

The vial and its contents should be stored inside its transportation container at room temperature (15-25° C, 59-77° F).

The calibration date (for radioactive contents) and the expiration information are quoted on the vial label. The useful life of the SIR-Spheres microspheres is 24 hours from the time of calibration. The particle size has been validated before shipment, as 32.5µ +/- 2.5 µ. Less than 10% will be < 30 µ and > 35 µ.

APPENDICES

APPENDIX I – GENERAL INFORMATION

Restricted to Accredited Facilities

SIR-Spheres microspheres may only be dispatched to a duly licensed or accredited facility capable of handling therapeutic medical isotopes.

Restricted to Licensed Physicians

This device is licensed by the Agency for distribution to persons licensed pursuant to 105 CMR 120.500, 120.541 and 120.543 or under equivalent licenses of the Nuclear Regulatory Commission, an Agreement State, or a licensing State. Only doctors qualified and licensed under Title 10 Code of Federal Regulations Part 35 (Nuclear Regulatory Commission) may order and implant SIR-Spheres microspheres.

APPENDIX II – DOSE PREPARATION PROCEDURE

- Unpack SIR-Spheres microspheres, leaving shipping vial in lead pot.
- Place on the bench top in a lead or acrylic shielded box if available.
- Remove the center of aluminum seal from sterile v-vial with forceps, and clean the septum with an alcohol swab.
- Place the v-vial in an empty lead pot (10 cm x 6 cm) for stability and shielding.
- Insert a short 25 gauge needle through the septum of the v-vial until it just pierces the septum to create a vent
- Remove the SIR-Spheres microspheres shipping vial from the lead pot and shake vigorously to disperse the SIR-Spheres microspheres.
- Using a dose calibrator, determine the activity in the shipping vial and return it to the lead pot.
- Remove partially the aluminum seal of the SIR-Spheres microspheres shipping vial, clean with alcohol swab.
- Insert a 25 gauge needle through the septum of the shipping vial to create a vent, ensuring the needle is well clear of the contents in the shipping vial.
- Use a shielded 5ml syringe with a 21 gauge hypodermic needle at least 50mm long to puncture the septum of the SIR-Spheres microspheres shipping vial, and quickly draw back and forth several times in order to mix the SIR-Spheres microspheres thoroughly.
- Quickly withdraw the pre-calculated patient radiation dose, and transfer into the vented v-vial in the other lead pot. Withdraw the required amount quickly before the contents of the shipping vial start to settle.
- Verify the patient dose in the v-vial by re-measuring the activity in the shipping vial with dose calibrator, and correct, if necessary.
- Put the v vial, containing the confirmed patient dose into the dedicated acrylic shield.

The patient dose is now ready for transport to the SIR-Spheres microspheres implantation room.

APPENDIX III – CALCULATION OF INDIVIDUAL DOSE

There are generally two acceptable methods in calculating the individual patient dose; the partition model (individual dose calculation), and empirical model. The empirical model accepts the safety margins of the dose known from the previously published clinical data and chooses the most safe and effective dose from it. The empirical model has been used in the pivotal clinical trial of the SIR-Spheres microspheres.

The patient dose can be determined according to the following Table 1.

Table 1 – The Recommended Patient Dose

The % Involvement by the Tumor in the Liver	Recommended Y-90 Dose*
> 50 %	3.0 GBq
25 % - 50 %	2.5 GBq
< 25 %	2.0 GBq

Caution: The recommended implanted activities are specific to SIR-Spheres microspheres. They are not applicable and should not be extrapolated to other implanted Y-90 sources.

- When there is 10 % or more lung shunting, the patient dose would be further reduced, according to the following table 2.

Table 2 – Dose Reduction Factors for Patients with Lung Shunting

% Lung Shunting	Reduction Factor
< 10 %	No reduction
10 % - 15 %	20 % reduction
15 % - 20 %	40 % reduction
> 20 %	No Treatment

Lung Shunt Calculation Procedure

- Inject 4 mCi (150MBq) of Tc-99m MAA into the hepatic artery via a port or catheter;
- Use a large FOV gamma camera, and obtain anterior and posterior images of the chest and abdomen (with 700k to 1 million counts on abdomen, and the same count on the chest);
- Take right lateral abdomen, using same count;
- Draw ROI around the whole liver and the whole lung and get the total counts for the lung and the liver;
- Calculate the % shunt using following formula:

% Shunt = (Lung Counts / Liver Counts + Lung Counts) x 100

APPENDIX IV – RADIATION DOSIMETRY

The radiation dosimetry of the SIR-Spheres microspheres can be a complex and difficult task due to the non-uniform distribution of the particles in the normal liver and the tumors. In general, 1 GBq (27 mCi) of Yttrium-90/kg of tissue provides 50 Gy of radiation dose.[1] However, because of the non-uniform distribution of the dose between the tumor and the normal liver tissue, a proportionally larger amount of radiation will be delivered to the tumor tissue, and less amount to the liver.

For example, a patient has a liver weighing 1500 g, and has two tumor nodules, a 4cm size tumor in the right lobe, and a 3cm size nodule in the left lobe. The post-injection images suggest that there is 5:1 density ratio for unit volume between the tumor and the liver. The patient received 2 GBq of SIR-Spheres microspheres. In such a case, the calculated radiation dose to the tumor is 294 Gy and the dose to the liver tissue is 58.5 Gy. The radiation dose for other organs would be minimal or negligible, except for the organs adjacent to the liver, such as the stomach, large intestine, gall bladder, and the lung. The radiation dose may increase significantly, when there is shunting of the arterial blood to the lung, stomach, or small intestine.

APPENDIX V – TECHNIQUE FOR PERFORMING THE INTRA-HEPATIC TECHNETIUM MAA SCAN

Purpose:	To assess arterial perfusion of the liver and the fraction of radiopharmaceutical tracer that will pass through the liver and lodge in the lungs
Agent:	Technetium-99 labeled MAA (Macro-Aggregated Albumin)
Dose:	150MBq (4 mCi)
Equipment:	Any large FOV gamma camera
Administration:	The patient needs to have a surgically implanted port or trans-femoral catheter placed in the hepatic artery. The Technetium-99 labeled MAA is injected into the port or catheter.
Imaging:	The patient is positioned supine under the gamma camera and the images recorded • Anterior and posterior images of abdomen and thorax Collect 700k – 1000k cts for abdomen and same time for thorax • Right lateral abdomen – same time acquisition as for anterior
Analysis:	Draw ROI around whole of liver and whole of lung fields. Calculate G mean for liver region and lung region Calculate Lung/Liver ratio using the following formula % lung shunting = (counts of total lung/counts of total lung plus counts of liver) x 100
Interpretation:	If percent lung shunting is >10% then there is need for dose reduction of SIR-Spheres microspheres (*see Table 1 below*)

Table 1 – Dose Reduction Recommendations

Per Cent Lung Shunting	Activity of SIR-Spheres microspheres
< 10%	Deliver full amount of SIR-Spheres microspheres
10% to 15%	Reduce amount of SIR-Spheres microspheres by 20%
15% to 20%	Reduce amount of SIR-Spheres microspheres by 40%
> 20 %	Do not give SIR-Spheres microspheres

APPENDIX VI – CORRECTION FOR DECAY

The physical half-life of yttrium-90 is 64.1 hours. Radioactive decay factors should be applied at the time of patient dose preparation, in order to calculate the true value of radioactivity present.

Table 1 – Decay Factors of Yttrium-90 SIR-Spheres microspheres

Hours	Decay Factor
0.5	0.995
1	0.989
2	0.979
3	0.968
4	0.956
5	0.947
6	0.937
7	0.927
8	0.917
9	0.907
10	0.898
11	0.888
12	0.878
24	0.772
36	0.678
48	0.595
72	0.459

Caution: The time of the initial calibration must be converted to the user's local time.

[1] Russell, Carden, Herron: 'Dosimetry Calculations of Yttrium-90 used in the treatment of liver cancer.' Endocurietherapy/Hypertherm Oncol. 1988;4:171-186.

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November 12, 2010

Dr. Douglas Prager
Nuclear Medicine Department
Queen's Medical Center
1301 Punchbowl St.
Honolulu, HI 96813

Dear Dr. Prager:

Re: SIR-Spheres® Microspheres Authorized User Training and Certification

This letter certifies that on 11/11/2010, you successfully completed training in the operation of the delivery system, safety procedures and clinical use of SIR-Spheres yttrium-90 microspheres that are to be injected via the hepatic artery to treat patients with unresectable liver tumors in accordance with the September 2008 NRC guidance. This training included three (3) supervised hands-on *in-vitro* simulated set-up and delivery procedures that demonstrate possible issues encountered during the yttrium-90 microsphere administration.

Following the license amendment that names you as an AU for SIR-Spheres yttrium-90 microspheres use, Sirtex will arrange for the first three (3) *in-vivo* patient cases to be performed in the physical presence of a Sirtex proctor.

Sirtex would like to thank you for your support in this process.

Yours sincerely,

Neal McMahon
Regional Sales Manager

cc: Brian Oyadomari, RSO

® SIR-Spheres is a Registered Trademark of Sirtex SIR-Spheres Pty Ltd

SIRTEX MEDICAL, INC.
16 Upton Drive, #2-4
Wilmington, MA 01887
Tel: 978 642 3000

November 12, 2010

Dr. Marc N. Coel
Chief, Nuclear Medicine Department
Queen's Medical Center
1301 Punchbowl St.
Honolulu, HI 96813

Dear Dr. Coel:

Re: SIR-Spheres® Microspheres Authorized User Training and Certification

This letter certifies that on 11/11/2010, you successfully completed training in the operation of the delivery system, safety procedures and clinical use of SIR-Spheres yttrium-90 microspheres that are to be injected via the hepatic artery to treat patients with unresectable liver tumors in accordance with the September 2008 NRC guidance. This training included three (3) supervised hands-on *in-vitro* simulated set-up and delivery procedures that demonstrate possible issues encountered during the yttrium-90 microsphere administration.

Following the license amendment that names you as an AU for SIR-Spheres yttrium-90 microspheres use, Sirtex will arrange for the first three (3) *in-vivo* patient cases to be performed in the physical presence of a Sirtex proctor.

Sirtex would like to thank you for your support in this process.

Yours sincerely,

Neal McMahon
Regional Sales Manager

cc: Brian Oyadomari, RSO

® SIR-Spheres is a Registered Trademark of Sirtex SIR-Spheres Pty Ltd

Enclosed: #1

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
9200 Corporate Boulevard
Rockville MD 20850

Monica Hope, Ph.D.
Sirtex Medical Inc.
% Mr. Alan Donald
Matrix Medical Consulting Corp.
16835 West Bernado Drive #120
SAN DIEGO CA 92127

MAR 5 2002

Re: P990065
SIR-Spheres®
Filed: October 25, 1999
Amended: December 10, 1999, February 10, May 2, July 6, August 8, October 20, 2000, and February 26, May 18 and 21, July 2 and 27, August 9 and 29, September 20, October 5 and 25, 2001, January 25 and 28, 2002
Procode: 90 NAW

Dear Dr. Hope:

The Center for Devices and Radiological Health (CDRH) of the Food and Drug Administration (FDA) has completed its review of your premarket approval application (PMA) for SIR-Spheres®. This device is indicated for the treatment of unresectable metastatic liver tumors from primary colorectal cancer with adjuvant intra-hepatic artery chemotherapy (IHAC) of FUDR (Floxuridine). We are pleased to inform you that the PMA is approved. You may begin commercial distribution of the device in accordance with the conditions described below and in the "Conditions of Approval" (enclosed).

The sale, distribution, and use of this device are restricted to prescription use in accordance with 21 CFR 801.109 within the meaning of section 520(e) of the Federal Food, Drug, and Cosmetic Act (the act) under the authority of section 515(d)(1)(B)(ii) of the act. FDA has also determined that, to ensure the safe and effective use of the device, the device is further restricted within the meaning of section 520(e) under the authority of section 515(d)(1)(B)(ii), (1) insofar as the labeling specify the requirements that apply to the training of practitioners who may use the device as approved in this order and (2) insofar as the sale, distribution, and use must not violate sections 502(q) and (r) of the act.

CDRH does not evaluate information related to contract liability warranties, however you should be aware that any such warranty statements must be truthful, accurate, and not misleading, and must be consistent with applicable Federal and State laws.

CDRH will notify the public of its decision to approve your PMA by making available a summary of the safety and effectiveness data upon which the approval is based. The information can be found on the FDA CDRH Internet HomePage located at http://www.fda.gov/cdrh/pmapage.html/ Written requests for this information can also be made to the Dockets Management Branch, (HFA-305), Food and Drug Administration, 5630 Fishers Lane, Rm. 1061, Rockville, MD 20852.

The written request should include the PMA number or docket number. Within 30 days from the date that this information is placed on the Internet, any interested person may seek review of this decision by requesting an opportunity for administrative review, either through a hearing or review by an independent advisory committee, under section 515(g) of the act.

Failure to comply with the conditions of approval invalidates this approval order. Commercial distribution of a device that is not in compliance with these conditions is a violation of the act.

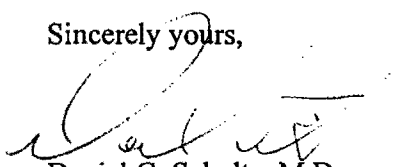
You are reminded that, as soon as possible and before commercial distribution of your device, you must submit an amendment to this PMA submission with copies of all approved labeling in final printed form. The labeling will not routinely be reviewed by FDA staff when PMA applicants include with their submission of the final printed labeling a cover letter stating that the final printed labeling is identical to the labeling approved in draft form. If the final printed labeling is not identical, any changes from the final draft labeling should be highlighted and explained in the amendment.

All required documents should be submitted in triplicate, unless otherwise specified, to the address below and should reference the above PMA number to facilitate processing.

PMA Document Mail Center (HFZ-401)
Center for Devices and Radiological Health
Food and Drug Administration
9200 Corporate Blvd.
Rockville, Maryland 20850

If you have any questions concerning this approval order, please contact John C. Monahan at (301) 594-1212.

Sincerely yours,



Daniel G. Schultz, M.D.
Deputy Director for Clinical
and Review Policy
Office of Device Evaluation
Center for Devices and Radiological Health

Enclosure

Last Modified: 1-31-02

CONDITIONS OF APPROVAL

PREMARKET APPROVAL APPLICATION (PMA) SUPPLEMENT. Before making any change affecting the safety or effectiveness of the device, submit a PMA supplement for review and approval by FDA unless the change is of a type for which a "Special PMA Supplement-Changes Being Effected" is permitted under 21 CFR 814.39(d) or an alternate submission is permitted in accordance with 21 CFR 814.39(e) or (f). A PMA supplement or alternate submission shall comply with applicable requirements under 21 CFR 814.39 of the final rule for Premarket Approval of Medical Devices.

All situations which require a PMA supplement cannot be briefly summarized, please consult the PMA regulation for further guidance. The guidance provided below is only for several key instances.

A PMA supplement must be submitted when unanticipated adverse effects, increases in the incidence of anticipated adverse effects, or device failures necessitate a labeling, manufacturing, or device modification.

A PMA supplement must be submitted if the device is to be modified and the modified device should be subjected to animal or laboratory or clinical testing designed to determine if the modified device remains safe and effective.

A "Special PMA Supplement - Changes Being Effected" is limited to the labeling, quality control and manufacturing process changes specified under 21 CFR 814.39(d)(2). It allows for the addition of, but not the replacement of previously approved, quality control specifications and test methods. These changes may be implemented before FDA approval upon acknowledgment by FDA that the submission is being processed as a "Special PMA Supplement - Changes Being Effected." This procedure is not applicable to changes in device design, composition, specifications, circuitry, software or energy source.

Alternate submissions permitted under 21 CFR 814.39(e) apply to changes that otherwise require approval of a PMA supplement before implementation of the change and include the use of a 30-day PMA supplement or annual postapproval report (see below). FDA must have previously indicated in an advisory opinion to the affected industry or in correspondence with the applicant that the alternate submission is permitted for the change. Before such can occur, FDA and the PMA applicant(s) involved must agree upon any needed testing protocol, test results, reporting format, information to be reported, and the alternate submission to be used.

Alternate submissions permitted under 21 CFR 814.39(f) for manufacturing process changes include the use of a 30-day Notice. The manufacturer may distribute the device 30 days after the date on which the FDA receives the 30-day Notice, unless the FDA notifies the applicant within 30 days from receipt of the notice that the notice is not adequate.

POSTAPPROVAL REPORTS. Continued approval of this PMA is contingent upon the submission of postapproval reports required under 21 CFR 814.84 at intervals of 1 year from the date of approval of the original PMA. Postapproval reports for supplements approved under the original PMA, if applicable, are to be included in the next and subsequent annual reports for the original PMA unless specified otherwise in the approval order for the PMA supplement. Two copies identified as "Annual Report" and bearing the applicable PMA reference number are to be submitted to the PMA Document Mail Center (HFZ-401), Center for Devices and Radiological Health, Food and Drug Administration, 9200 Corporate Blvd., Rockville, Maryland 20850. The postapproval report shall indicate the beginning and ending date of the period covered by the report and shall include the following information required by 21 CFR 814.84:

(1)Identification of changes described in 21 CFR 814.39(a) and changes required to be reported to FDA under 21 CFR 814.39(b).

(2) Bibliography and summary of the following information not previously submitted as part of the PMA and that is known to or reasonably should be known to the applicant:

(a)unpublished reports of data from any clinical investigations or nonclinical laboratory studies involving the device or related devices ("related" devices include devices which are the same or substantially similar to the applicant's device); and

(b)reports in the scientific literature concerning the device.

If, after reviewing the bibliography and summary, FDA concludes that agency review of one or more of the above reports is required, the applicant shall submit two copies of each identified report when so notified by FDA.

ADVERSE REACTION AND DEVICE DEFECT REPORTING. As provided by 21 CFR 814.82(a)(9), FDA has determined that in order to provide continued reasonable assurance of the safety and effectiveness of the device, the applicant shall submit 3 copies of a written report identified, as applicable, as an "Adverse Reaction Report" or "Device Defect Report" to the PMA Document Mail Center (HFZ-401), Center for Devices and Radiological Health, Food and Drug Administration, 9200 Corporate Blvd., Rockville, Maryland 20850 within 10 days after the applicant receives or has knowledge of information concerning:

(1)A mix-up of the device or its labeling with another article.

(2)Any adverse reaction, side effect, injury, toxicity, or sensitivity reaction that is attributable to the device and

(a)has not been addressed by the device's labeling or

(b)has been addressed by the device's labeling, but is occurring with unexpected severity or frequency.

(3)Any significant chemical, physical or other change or deterioration in the device or any failure of the device to meet the specifications established in the approved PMA that could not cause or contribute to death or serious injury but are not correctable by adjustments or other maintenance procedures described in the approved labeling. The report shall include a discussion of the applicant's assessment of the change, deterioration or failure and any proposed or implemented corrective action by the applicant. When such events are correctable by adjustments or other maintenance procedures described in the approved labeling, all such events known to the applicant shall be included in the Annual Report described under "Postapproval Reports" above unless specified otherwise in the conditions of approval to this PMA. This postapproval report shall appropriately categorize these events and include the number of reported and otherwise known instances of each category during the reporting period. Additional information regarding the events discussed above shall be submitted by the applicant when determined by FDA to be necessary to provide continued reasonable assurance of the safety and effectiveness of the device for its intended use.

REPORTING UNDER THE MEDICAL DEVICE REPORTING (MDR) REGULATION. The Medical Device Reporting (MDR) Regulation became effective on December 13, 1984. This regulation was replaced by the reporting requirements of the Safe Medical Devices Act of 1990 which became effective July 31, 1996 and requires that all manufacturers and importers of medical devices, including in vitro diagnostic devices, report to the FDA whenever they receive or otherwise become aware of information, from any source, that reasonably suggests that a device marketed by the manufacturer or importer:

(1)May have caused or contributed to a death or serious injury; or

(2)Has malfunctioned and such device or similar device marketed by the manufacturer or importer would be likely to cause or contribute to a death or serious injury if the malfunction were to recur.

The same events subject to reporting under the MDR Regulation may also be subject to the above "Adverse Reaction and Device Defect Reporting" requirements in the

"Conditions of Approval" for this PMA. FDA has determined that such duplicative reporting is unnecessary. Whenever an event involving a device is subject to reporting under both the MDR Regulation and the "Conditions of Approval" for a PMA, the manufacturer shall submit the appropriate reports required by the MDR Regulation within the time frames as identified in 21 CFR 803.10(c) using FDA Form 3500A, i.e., 30 days after becoming aware of a reportable death, serious injury, or malfunction as described in 21 CFR 803.50 and 21 CFR 803.52 and 5 days after becoming aware that a reportable MDR event requires remedial action to prevent an unreasonable risk of substantial harm to the public health. The manufacturer is responsible for submitting a baseline report on FDA Form 3417 for a device when the device model is first reported under 21 CFR 803.50. This baseline report is to include the PMA reference number. Any written report and its envelope is to be specifically identified, e.g., "Manufacturer Report," "5-Day Report," "Baseline Report," etc.

Any written report is to be submitted to:

Food and Drug Administration
Center for Devices and Radiological Health
Medical Device Reporting
PO Box 3002
Rockville, Maryland 20847-3002

Copies of the MDR Regulation (FOD # 336&1336)and FDA publications entitled "An Overview of the Medical Device Reporting Regulation" (FOD # 509) and "Medical Device Reporting for Manufacturers" (FOD #987) are available on the CDRH WWW Home Page. They are also available through CDRH's Fact-On-Demand (F-O-D) at 800-899-0381. Written requests for information can be made by sending a facsimile to CDRH's Division of Small Manufacturers International and Consumer Assistance (DSMICA) at 301-443-8818.

APR - 5 2011

DATE

This is to acknowledge the receipt of your letter/application dated 3/17/11, and to inform you that the initial processing, which includes an administrative review, has been performed.

☑ There were no administrative omissions. Your application will be assigned to a technical reviewer. Please note that the technical review may identify other omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card:

The action you requested is normally processed within 90 days.

☐ A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 574798.
When calling to inquire about this action, please refer to this mail control number.
You may call me at (817) 860-8103.

Sincerely,

Carol L Hicie

Licensing Assistant

NRC FORM 532 (RIV)
(10-2010)

BETWEEN:

Accounts Receivable/Payable
and
Regional Licensing Branches

[FOR ARPB USE]
INFORMATION FROM LTS

Program Code: 02230
Status Code: Pending Amendment
Fee Category: 3E 7C
Exp. Date:
Fee Comments:
Decom Fin Assur Reqd: N

License Fee Worksheet - License Fee Transmittal

A. REGION

1. APPLICATION ATTACHED

Applicant/Licensee:	QUEEN'S MEDICAL CENTER, THE
Received Date:	03/28/2011
Docket Number:	3014522
Mail Control Number:	574798
License Number:	53-16533-02
Action Type:	Amendment

2. FEE ATTACHED

Amount: ~~_____~~

Check No.: ~~_____~~

3. COMMENTS

Signed: Colleen Murnahan

Date: 3-31-2011

B. LICENSE FEE MANAGEMENT BRANCH (Check when milestone 03 is entered / /)

1. Fee Category and Amount: _____

2. Correct Fee Paid. Application may be processed for:

Amendment: _____

Renewal: _____

License: _____

3. OTHER _____

_____

Signed: _____

Date: _____

ORIGIN ID: HIKA (808) 547-4348
SHIPPING
QUEENS MEDICAL CENTER
1301 PUNCHBOWL ST

HONOLULU, HI 96813
UNITED STATES US

SHIP DATE: 24MAR11
ACTWGT: 0.5 LB
CAD: 0751243/CAFE2472

BILL THIRD PARTY

TO **NUCLEAR MATERIALS LICENSING BRANCH**
U.S. NRC REGION IV
611 RYAN PLAZA DRIVE SUITE #400

RECEIVED

ARLINGTON TX 760118064
REF: CC:2418

MAR 28 2011

DEPT: RADIATION THERAPY

FedEx Express

J1010100901012A

MON - 28 MAR A1
**** 2DAY ****

TRK# 0201 **4636 4597 5239**

76011
TX-US
DFW

SR FWHA

505C2/BDD9/DA47

Nuclear Materials Licensing Branch
U.S. NRC Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

RECEIVED
MAR 28 2011
DNMS