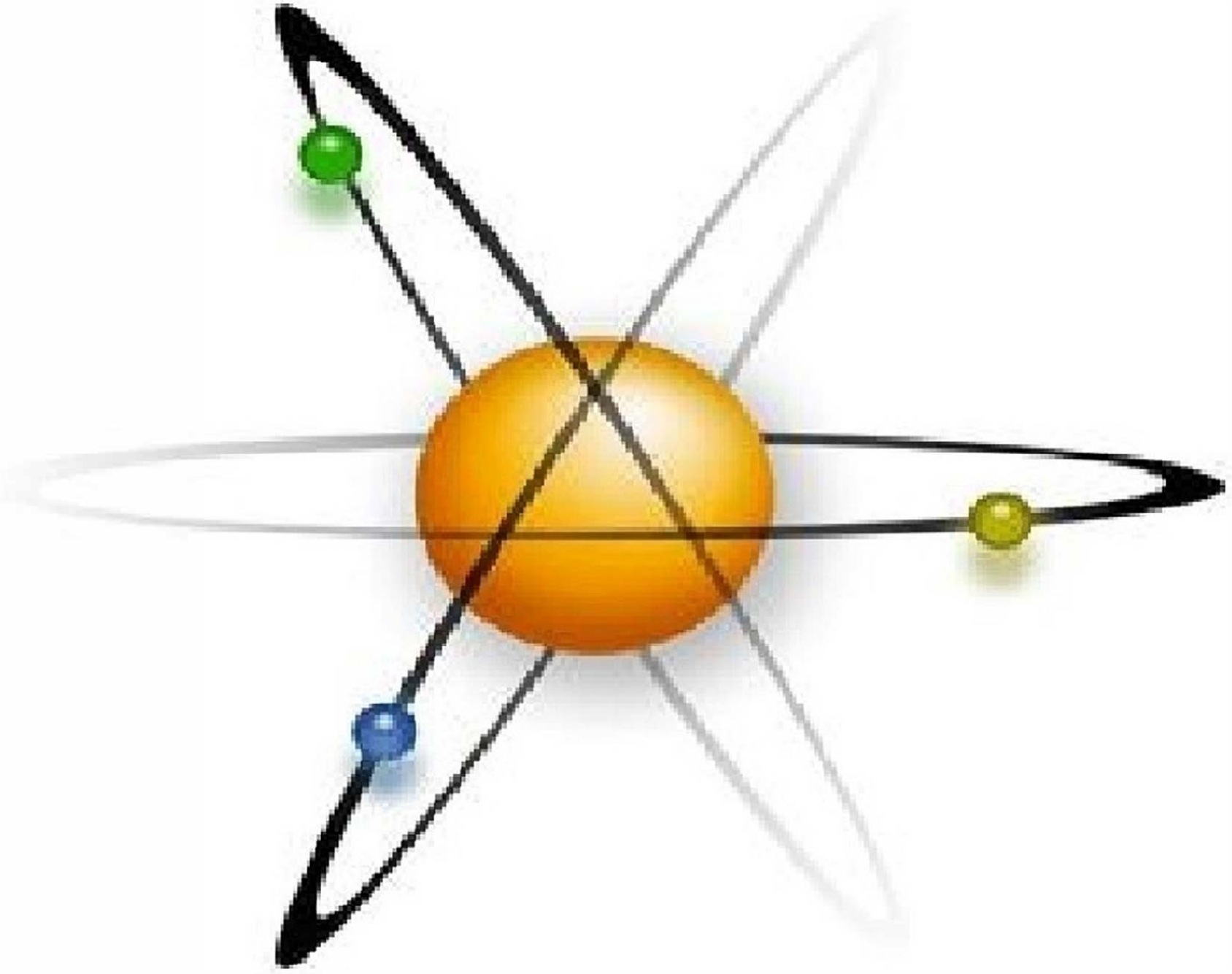

Advisory Committee on the Medical Uses of Isotopes

March 7-8, 2018

MEETING AGENDA
ADVISORY COMMITTEE ON THE MEDICAL USES OF ISOTOPES
March 7-8, 2018
Two White Flint North Building (T2-B3), Rockville, Maryland

NOTE: Sessions of the meeting may be closed pursuant to 5 U.S.C. 552(b) to discuss organizational and personnel matters that relate solely to internal personnel rules and practices of the ACMUI; information the release of which would constitute a clearly unwarranted invasion of personal privacy; information the premature disclosure of which would be likely to significantly frustrate implementation of a proposed agency action; and disclosure of information which would risk circumvention of an agency regulation or statute.

Wednesday, March 7, 2018 OPEN SESSION			
8:30 – 10:15	**1.**	**Opening Remarks** Mr. Bollock will formally open the meeting and Ms. Howell will provide opening comments.	**D. Bollock, NRC L. Howell, NRC**
	2.	**Old Business** Ms. Holiday will review past ACMUI recommendations and provide NRC responses.	**S. Holiday, NRC**
	3.	**Open Forum** The ACMUI will identify medical topics of interest for further discussion.	**ACMUI**
	4.	**Medical Related Events** Dr. Howe will provide an update on recent medical events.	**DB. Howe, NRC**
10:15 – 10:30		**BREAK**	
10:30 – 11:30	**5.**	**Staff Response to Medical Event Reporting and its Impacts on Safety Culture Subcommittee Report** Mr. Bollock will discuss the staff's evaluation of the ACMUI's recommendations related to how NRC's medical event reporting criteria under 10 CFR 35.3045 impacts safety culture at medical institutions.	**D. Bollock, NRC**
	6.	**ACMUI Reporting Structure** Members will discuss the reporting structure of the Committee and provide feedback to NRC staff.	**S. Holiday, NRC**
11:30 – 1:00		**LUNCH**	
1:00 – 2:30	**7.**	**Worldwide Supply and the Domestic Production of Molybdenum-99** Mr. Green will provide an update of the world's supply of and the domestic production of molybdenum-99 in the U.S.	**R. Green, Cardinal Health**
	8.	**Medical Projects on the Horizon** Mr. Bollock will discuss the major assignments currently under review by the medical radiation safety team.	**D. Bollock, NRC**
2:30 – 3:00		**BREAK** (public portion ends)	
3:00 – 5:00	**9.**	**ACMUI Working Prepatory Session**	

Thursday, March 8, 2018 OPEN SESSION		
	10. Special Presentation to Dr. Zanzonico Mr. Dapas will make a special presentation to Dr. Zanzonico.	**M. Dapas, NRC**
8:30 – 9:00	**11. Emerging Technologies Commission Paper** Ms. Wu will provide an overview of a paper that was provided to the Commission related to the resources needed to address the development of emerging technologies.	**I. Wu, NRC**
9:30 – 10:00	**BREAK**	
10:00 – 12:15	**12. Commission Meeting with the ACMUI** The ACMUI will brief the Commission on various topics in a public meeting.	**ACMUI**
	13. Group Photo The ACMUI will take a group photo with and without the Commission.	**ACMUI**
12:15 – 1:30	**LUNCH**	
	14. Thoughts on Leaving the ACMUI Dr. Zanzonico will share his thoughts on leaving the ACMUI.	**P. Zanzonico, ACMUI**
1:30 – 2:45	**15. Open Forum** The ACMUI will discuss medical topics of interest previously identified.	**ACMUI**
2:45	**16. Administrative Closing** Ms. Holiday will provide a meeting summary and propose dates for the fall 2018 meeting.	**S. Holiday, NRC**
	ADJOURN	

Opening Remarks

NO HANDOUT

2007 ACMUI RECOMMENDATIONS AND ACTION ITEMS

	ITEM	DATE	STATUS	
2	NRC staff should remove the attestation requirement for board certified individuals and rewrite the attestation requirement for individuals seeking authorization under the alternate pathway. The rewritten attestation should not include the word “competency” but should instead read “has met the training and experience requirements.”	6/12/07	Accepted	Open
3	NRC staff should revise the regulations so that board certified individuals, who were certified prior to the effective date of recognition or were certified by previously recognized boards listed in Subpart J of the previous editions of Part 35, are grandfathered.	6/12/07	Accepted	Open
6	NRC staff should add the words “or equivalent” so it is clear that information included in a letter is the same as that which would have been submitted in NRC Form 313A (35.12(c))	6/13/07	Accepted	Open
7	NRC staff should revise 10 CFR 35.50(c)(2) to include AUs, AMPs, or ANPs identified on any license or permit that authorizes similar types of use of byproduct material. Additionally, the AU, AMP, or ANP must have experience with the radiation safety aspects of similar types of use of byproduct material for which the individual is seeking RSO authorization.	6/13/07	Accepted	Open
8	NRC staff should remove the attestation requirement from 10 CFR 35.50(d) for AUs, AMPs, and ANPs seeking RSO status, if the AU, AMP, or ANP seeking RSO status will have responsibilities for similar types of uses for which the individual is authorized.	6/13/07	Accepted	Open

	ITEM	DATE	STATUS	
10	a) NRC staff should allow more than one RSO on a license with a designation of one RSO as the individual in charge. b) NRC should create a Regulatory Issue Summary (RIS) to inform the regulated community of NRC's interpretation. The RIS should be sent to ACMUI and the Agreement States for review and comment.	6/13/07	a) Accepted b) Accepted	a) Open b) Closed
25	NRC staff should revise the current regulations to include Canadian trained individuals who have passed the ABNM certification exam.	8/16/07	Accepted	Open
30	The Elekta Perfexion® should be regulated under 10 CFR 35.1000 until 10 CFR 35.600 is modified to be performance-based, which would allow the Perfexion® to be regulated under 10 CFR 35.600.	10/22/07	Accepted	Open *Delayed*
31	NRC staff should require experienced RSOs and AMPs to receive additional training, if the individual is seeking authorization or responsibility for new uses.	10/22/07	Accepted	Open
32	NRC staff should not require experienced RSOs to obtain written attestation to become authorized or have responsibility for new uses.	10/22/07	Accepted	Open
34	NRC staff should modify 10 CFR 35.491(b)(2) to specify 'superficial' ophthalmic treatments. Additionally, NRC staff should change the title of 10 CFR 35.491 to specify 'superficial' ophthalmic treatments.	10/22/07	Accepted	Open *Delayed*
35	NRC staff should not revise 10 CFR 35.491 (intended for ophthalmologists) to include training and experience for the new intraocular device. Instead, NRC staff should regulate the new intraocular device under 10 CFR 35.490.	10/22/07	Partially Accepted	Open *Delayed*

	ITEM	DATE	STATUS	
36	NRC staff should not require medical licensees regulated under 10 CFR 35.400, 500, or 600, as applicable, to only use the sealed sources and devices for the principle use as approved in the SSDR.	10/22/07	Accepted	Open
37	NRC staff should revise 10 CFR 35.290 to allow physicians to receive training and experience in the elution of generators and preparation of kits under the supervision of an ANP.	10/22/07	Accepted	Open

2008 ACMUI RECOMMENDATIONS AND ACTION ITEMS

	ITEM	DATE	STATUS	
2	NRC staff should pursue rulemaking to allow more than one RSO on a medical use license with the indication of one RSO as the individual in charge.	4/28/08	Accepted	Open
5	NRC staff should incorporate the subcommittee's recommendations for the Gamma Knife® Elekta Perfexion™ in future rulemaking.	4/28/08	Accepted	Open *Delayed*
19	NRC staff should accept the six recommendations of the Permanent Implant Brachytherapy Subcommittee report with one modification. Recommendation six should be modified to read, "When a Written Directive (WD) is required, administrations without a prior WD are to be reported as regulatory violations and may or may not constitute an ME."	10/27/08	Pending	Open *Delayed*
22	ACMUI encouraged NRC staff to begin the rulemaking process to move the medical use of Y-90 microspheres from 10 CFR 35.1000 to another section of the regulations, so that the training and experience requirements for AUs can be vetted though the public review process instead of residing in guidance space.	10/27/08	Partially accepted	Open *Delayed*
26	NRC staff should revise 10 CFR 35.40 to clarify that the AU should sign and date both the pre-implantation and post-implantation portions of the WD for all modalities with two part WDs	10/28/08	Accepted	Open *Delayed*

2008 ACMUI RECOMMENDATIONS AND ACTION ITEMS

	ITEM	DATE	STATUS	
27	NRC staff should revise 10 CFR 35.40 to clarify that an AU, not the AU, should sign and date both the pre-implantation and post-implantation portions of the WD for all modalities with two part WDs. [Note this allows for one AU to sign the pre-implantation portion of the WD and another AU to sign the post-implantation portion of the WD]	10/28/08	Accepted	Open *Delayed*
28	NRC staff should revise 10 CFR 35.65 to clarify it does not apply to sources used for medical use; however, NRC should not require licensees to list the transmission sources as a line item on the license. NRC staff should also revise 10 CFR 35.590 to permit the use of transmission sources under 10 CFR 35.500 by AUs meeting the training and experience requirements of 10 CFR 35.590 or 35.290.	10/28/08	Accepted	Open
29	NRC staff should revise 10 CFR 35.204(b) to require a licensee that uses Mo 99/Tc-99m generators for preparing a Tc-99m radiopharmaceutical to measure the Mo-99 concentration of each eluate after receipt of a generator to demonstrate compliance with not administering to humans more than 0.15 microcurie Mo-99 per millicurie Tc-99m.	10/28/08	Accepted	Open
30	NRC staff should require licensees to report to the NRC events in which licensees measure molybdenum breakthrough that exceeds the regulatory limits.	10/28/08	Accepted	Open

2009 ACMUI RECOMMENDATIONS AND ACTION ITEMS

	ITEM	DATE	STATUS	
2	NRC staff should revise 35.390(b)(1)(ii)(G)(3) to read "parenteral administration requiring a written directive for any radionuclide that is being used primarily because of its beta emission, or low energy photo-emission, or auger electron; and/or" and revise 35.390(b)(1)(ii)(G)(4) to read "parenteral administration requiring a written directive for any radionuclide that is being used primarily because of its alpha particle emission"	5/7/09	Accepted	Open
10	ACMUI recommends NRC staff delete the phrase "at a medical institution" from 10 CFR 35.2, 35.490(b)(1)(ii), 35.491(b)(2) and 35.690(b)(1)(ii).	10/19/09	Accepted	Open

	ITEM	DATE	STATUS		1st/2nd	Vote
1	ACMUI endorsed the draft response to NRC comments, as reflected in the meeting handout (ML110600249). ACMUI agreed if NRC believes the release criteria should be changed from a per release criteria to an annual criteria, this change would require new rulemaking, as stated in Regulatory Issue Summary (RIS) 2008-07. ACMUI recommended rulemaking to clarify that the release under 10 CFR 35.75 is per release and not per year	1/5/11	Pending	Open	Langhorst/Gilley	9, 1, 0
6	ACMUI created an action item to reevaluate its satisfaction with the reporting structure annually.	1/12/11	ACMUI Action	Open indefinitely	Welsh/Zanzonico	
11	(1) ACMUI feels ASTRO's approach to Permanent Implant Brachytherapy (handout) is correct approach for patient welfare (2) ACMUI recommends that the NRC require Post-Implant dosimetry following brachytherapy treatment (3) ACMUI believes that prostate brachytherapy is a unique subset of brachytherapy and should therefore require a separate set of rules from non-prostate brachytherapy.	4/11/11	Partially Accepted	Open	Welsh/Mattmuller	11, 0, 0

	ITEM	DATE	STATUS		1st/2nd	Vote
13	ACMUI recommends to eliminate the written attestation for board certification pathway, regardless of date of certification	4/12/11	Accepted	Open	Zanzonico/Guiberteau	11, 0, 0
14	ACMUI recommends the attestation to be revised to say … has received the requisite training and experience in order to fulfill the radiation safety duties required by the licensee	4/12/11	Accepted	Open	Langhorst/Thomadsen	11, 0, 0
15	ACMUI supports the statement that residency program directors can sign attestation letters, representing consensus of residency program faculties, if at least one member of the faculty is an AU in the same category as that designated by the applicant seeking authorized status, and that AU did not disagree with the approval.	4/12/11	Accepted	Open	Thomadsen/Welsh	11, 0, 0
16	ACMUI continues to assert that the current regulations are based on a per release limit. ACMUI does not recommend any change to the regulation and does not recommend the NRC consider this topic during the current rulemaking process, as there is no clinical advantage or advantage to members of the public for using an annual limit.	4/12/11	Pending	Open	Langhorst/Welsh	11, 0, 0

	ITEM	DATE	STATUS		1st/2nd
1	ACMUI recommended NRC staff allow use of total source strength as a substitute for total dose for determining medical events for permanent implant brachytherapy until the Part 35 rulemaking is complete.	3/5/13	NRC Action	Open	
2	ACMUI recommended that NRC staff solicit feedback from stakeholders, in Supplementary Information section IV.D, on whether the proposed ME definition for permanent implant brachytherapy would discourage licensees from using this form of therapy. This recommendation was modified the caveat that NRC may utilize the language that they think is appropriate for gaining this type of information from its stakeholders	3/5/13	NRC Action	Open	Zanzonico/Langhorst
3	ACMUI recommended the draft rule re-defining medical events in permanent implant brachytherapy be designated as Compatibility Category B.	3/5/13 3/12/13	NRC Action	Open	
4	ACMUI recommended replacing the phrasing in the literature in terms of support for the 5 cubic centimeters of contiguous normal tissue provision of the ME definition, to the specific reference cited as, Nag, et al 2004	3/5/13	NRC Action	Open	

	ITEM	DATE	STATUS		1st/2nd
5	ACMUI recommended that licensees approved to use generator systems show specific training on the requirement now listed under 35.290 (c)(1)(ii)(G) for those individuals (Authorized Users and others) who are responsible for proper operation and testing of the generator as part of their license conditions. ACMUI further recommended that Authorized Nuclear Pharmacists who have the adequate training and experience (T&E) are able to provide the supervised work experience for Authorized Users on the elution of generators.	3/5/13	NRC Action	Open	
6	ACMUI endorsed the language in the proposed rule for preceptor attestations that states a candidate is able to independently fulfill the radiation safety related duties for which authorization is being sought.	3/5/13	NRC Action	Open	
7	ACMUI recommended that the work experience for parenteral administrations under Sections 35.390 (b)(1)(2)(g), and 35.396 not be separated between parenteral administrations of a beta gamma emitting radiopharmaceutical versus an alpha emitting radiopharmaceutical, as proposed in the proposed rule.	3/12/13	NRC Action	Open	Zanzonico/Guiberteau
8	ACMUI recommended that the date of recognition of a certifying board should not impact individuals seeking to be named as an Authorized User, Authorized Radiation Safety Officer, Authorized Medical Physicist, or Authorized Nuclear Pharmacist through the certification pathway.	3/12/13	NRC Action	Open	Zanzonico/Thomadsen
9	ACMUI recommended that the NRC adopt the FDA approved package insert for breakthrough limits for radioisotope generators	3/12/13	NRC Action	Open	Zanzonico/Mattmuller

	ITEM	DATE	STATUS		1st/2nd
10	ACMUI recommended licensee reporting of out-of-tolerance generator breakthrough results to the NRC	3/12/13	NRC Action	Open	Zanzonico/Weil
11	ACMUI recommended requiring testing of molybdenum breakthrough on every elution of a molybdenum-technetium generator, rather than after only the first elution.	3/12/13	NRC Action	Open	
12	ACMUI recommended that the addition of Associate Radiation Safety Officers (ARSOs), and Temporary RSOs also be included in these exemptions in the same manner as AUs, ANPs, and AMPs.	3/12/13	NRC Action	Open	Zanzonico/Langhorst
13	In reference to the plain language requirement, the ACMUI suggested that the rule “could be shortened and improved by eliminating redundancies and consolidating related sections and eliminating identical or nearly identical passages appearing multiple times throughout the draft rule. A further improvement would be the inclusion of a detailed “executive summary”-style section summarizing, perhaps in a bullet format, the key changes introduced in the draft rule.”	3/12/13	NRC Action	Open	

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote (Y/N/A)
7	The ACMUI recommended that events reportable under 10 CFR 35.3047 that do not result in harm to the embryo/fetus/or nursing child not be captured as AO's reported to Congress.	03/20/2015	ACMUI Action	Open		Langhorst/Costello	11, 0, 1
12	The ACMUI recommended to make the following change to the Patient Intervention Subcommittee Recommendation Issue II: Unintentional Treatment outcome due to anatomic or physiologic anomaly ~~and/or imaging uncertainty~~ falls into the category “the Art of Medical Practice” provided that the standards of medical practice are met.	10/8/15	ACMUI Action	Open	M. Ayoade	Alderson/Palestro	10, 0, 1
13	The ACMUI endorsed the Patient Intervention Subcommittee Report with the modification to Issue II (listed in item 12 above).	10/8/15	ACMUI Action	Open	M. Ayoade	Costello, Alderson	10, 1, 0
15	The ACMUI recommended that staff issue a Generic Communication (i.e. Information Notice or Regulatory Issue Summary) to licensees to inform them of the interpretation of "patient intervention."	10/8/15	NRC Action	Open	M. Ayoade		
22	The ACMUI endorsed the 2015 Abnormal Occurrence Criteria Subcommittee Report with the caveat that the report be amended to include an introductory paragraph that provides the rationale for the recommendations, as well as a summary paragraph to state that the Committee desires that the recommendations be incorporated into this revision of the NRC's Abnormal Occurrence Criteria Policy Statement.	10/9/15	ACMUI Action	Open			10, 1, 0

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote (Y/N/A)
1	The Committee endorsed that component of the current proposed rule re-defining medical events in permanent implant brachytherapy in terms of activity (i.e. source strength) rather than radiation dose).	1/6/2016	Accepted	Open			10, 0, 0
2	The Committee endorsed, with reservation, designating the current proposed rule re-defining medical events in permanent implant brachytherapy as Compatibility Category C, with activity-based medical event metrics defined as an essential program element.	1/6/2016	Accepted	Open			10, 0, 0
3	The Committee recommended changing the language for a "wrong-location" medical event in permanent implant brachytherapy from the current proposed language, "Sealed source(s) implanted directly into a location where the radiation from the source(s) will not contribute dose to the treatment site, as defined in the written directive," to **"Sealed source(s) implanted directly into a location discontiguous from the treatment site, as defined in the written directive."**	1/6/2016	Accepted	Open			10, 0, 0
4	The Committee recommended revising the passage in lines 4182-4186 on page 167 in the Draft Final Rule as follows, thereby eliminating the dose-based criteria for a leaking source" medical event: **"3) An administration that includes the wrong radionuclide; the wrong individual or human research subject; a leaking sealed source; or a sealed source or sources implanted into a location discontiguous from the treatment site, as defined in the written directive."**	1/6/2016	Not Accepted	Open			10, 0, 0
5	The Committee endorsed the elimination of the preceptor-statement requirement for Board-certified individuals for an individual seeking regulatory authorization as an authorized user, authorized medical physicist, Radiation Safety Officer, or authorized nuclear pharmacist.	1/6/2016	Accepted	Closed			10, 0, 0

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote (Y/N/A)
6	With respect to the amended requirements for preceptor attestation for an individual seeking regulatory authorization as an authorized user, authorized medical physicist, Radiation Safety Officer, or authorized nuclear pharmacist through the alternate pathway, the Committee endorsed changing the language for the preceptor attestation from the individual "…has achieved a level of competency to function independently…" for the authorization to **the individual can "…independently fulfill the radiation safety-related duties…" associated with the authorization being requested.**	1/6/2016	Accepted	Open			10, 0, 0
7	The Sub-Committee recommended that the date of recognition by the NRC of a certifying board should not impact individuals seeking to be named as an authorized user, authorized medical physicist, Radiation Safety Officer, or authorized nuclear pharmacist through the certification pathway. During the discussion, this recommendation was modified in the final report as follows: **The Sub-Committee recommends that NRC Staff consider providing guidance in the NUREG-1556, Volume 9 update to licensees on the ways individuals with board certifications prior to NRC's board recognition date may seek authorization.**	1/6/2016	Accepted	Open			10, 0, 0
8	The Committee recommended that the NRC adopt the parent-breakthrough limits for radioisotope generators specified in the relevant Food and Drug Administration (FDA)-approved package inserts. During the discussion, the Committee recommended to eliminate this recommendation and instead, revise the general comments section of the report to suggest that NRC consider, in future rulemaking, establishing conformity with the FDA breakthrough-limit regulations.	1/6/2016	ACMUI Action	Open			9, 1, 0
9	The Committee did not endorse the new requirement in the Draft Final Rule that licensees report to the NRC as well as to the manufacturer/vendor generator elutions with out-of-tolerance parent-breakthrough but, instead, recommends a single reporting requirement to the manufacturer/vendor.	1/6/2016	Not Accepted	Open			10, 0, 0
10	The Committee endorsed allowing Associate Radiation Safety Officers (ARSO) to be named on a medical license.	1/6/2016	Accepted	Open			10, 0, 0

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote (Y/N/A)
11	The Committee recommended that the designation of a board-certified authorized user, authorized medical physicist, or authorized nuclear pharmacist as the Radiation Safety Officer (RSO) or as an ARSO requires their board certification to include the designation, "RSO Eligible."	1/6/2016	Not Accepted	Open			10, 0, 0
12	The Committee did not endorse establishing a separate category of Authorized Users for parenteral administration of alpha-emitting radiopharmaceuticals but, instead, recommends deleting § 35.390(b)(1)(ii)(G)(4) in the current Draft Final Rule and revising the pertinent passage in § 35.390(b)(1)(ii)(G)(3) as follows, **"Parenteral administration of any radioactive drug for which a written directive is required."**	1/6/2016	Partially Accepted	Open			10, 0, 0
13	The Committee endorsed the elimination of the requirement to submit copies of NRC Form 313, Application for Material License, or a letter containing information required by NRC Form 313 when applying for a license, an amendment, or renewal.	1/6/2016	Accepted	Open			10, 0, 0
14	The Sub-Committee recommended changing the "medical-events" language in lines 5531-5532 (page 232) of the Draft Final Rule from, "A licensee shall report as a medical event, any administration requiring a written directive, except for an event that results from patient intervention…," back to the language in the current Draft Final Rule, "A licensee shall report any event, except for an event that results from patient intervention…" During the discussion, the recommendation was modified in the final report as follows: **The Sub-Committee recommends changing the "medical-events" language in lines 5531-5532 (page 232) of the current version of the Draft Final Rule from, "A licensee shall report any event, except for an event that results from patient intervention…" back to the language published in the Proposed Rule as presented for public comment,** **"A licensee shall report as a medical event, any administration requiring a written directive, except for an event that results from patient intervention…,"**	1/6/2016	Not Accepted	Open			10, 0, 0

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote (Y/N/A)
15	The Committee endorsed the 2016 Rulemaking Subcommittee Report with modifications as listed above.	1/6/2016	NRC Action	Open			10, 0, 0
16	Dr. Alderson formed a subcommittee to review and evaluate the training and experience requirements for all modalities in 10 CFR Part 35. Subcommittee members include: Dr. Langhorst, Dr. Metter, Dr. Palestro (chair), Dr. Suh and Ms. Weil. NRC staff resource: Maryann Abogunde.	2/25/2016	ACMUI Action	Open			
24	The ACMUI will contact their respective professional organizations to request and encourage interactions between the NRC and ACMUI with their organization.	3/18/2016	ACMUI Action	Open			
39	The Committee recommended that staff issue a generic communication (information notice) regarding tubing issues (kinking, connection, hub etc.) during the administration of Y-90 microspheres brachytherapy.	10/6/16	NRC Action	Open	Dr. Katie Tapp	Ennis/Costello	9, 0, 1
42	The Committee recommended that the Pathway 2 remain for the Y-90 Microsphere Brachytherapy Licensing Guidance. The NRC/OAS working group should determine what the requirements should be for the proctoring of cases by the manufacturer(s).	10/7/16	NRC Action	Open	Dr. Katie Tapp	Langhorst/Costello	9, 1, 1
43	The Committee recommended to support the update to the waste disposal section and the review of the Y-90 radiation safety issues in autopsy and cremation in the draft revision of the Y-90 Microsphere Brachytherapy Licensing Guidance.	10/7/16	NRC Action	Open	Dr. Katie Tapp	Langhorst/Ennis	11, 0 , 0
44	For the NorthStar Guidance Subcommittee: The Committee recommended that NorthStar provide a video clip of how the system operates in the training module.	10/7/16	NRC Action	Closed	Dr. Donna-Beth Howe		10, 0, 0
45	For the NorthStar Guidance Subcommittee: Given the unique design and operation of the NorthStar system, the Committee agreed that NorthStar should have sole responsibility for the content of the training course and certification.	10/7/16	NRC Action	Closed			10, 0, 0
46	For the NorthStar Guidance Subcommittee: The Committee stated that it is important to clarify that a System Administrator can be any individual assigned by the AU without a specifically defined educational or training background. Given the unique role of the System Administrator, perhaps that individual should be named on the license.	10/7/16	NRC Action	Closed			10, 0, 0

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote (Y/N/A)
47	For the NorthStar Guidance Subcommittee:The Committee recommended an explicit statement regarding the System Administrator Designee, although it may not have been intended, one could infer from the description of the system administrator designee that there can be only one designee. Presumably, there can, and should, be multiple System Administrator designees.	10/7/16	NRC Action	Closed			10, 0, 0
48	For the NorthStar Guidance Subcommittee:The Committee recommended that the appropriate time period allotted for training on the "changes" and the responsibility of the vendor/manufacturer to inform and train the applicants on changes in a timely manner be specified.	10/7/16	NRC Action	Closed			10, 0, 0
49	For the NorthStar Guidance Subcommittee: The Committee recommended that the guidance clarify whether the generator will be "non-operational" until ALL individuals handling the generator are trained in the changes, including the AU, RSO, system administrator, etc. or does it require only the AU to be trained on the "changes." If the latter, once the AU is trained on the "changes", is the AU then solely responsible for training all others on these changes? This should be stated.	10/7/16	NRC Action	Closed			10, 0, 0
50	For the NorthStar Guidance Subcommittee: The Committee recommended using the term, "individual tasks" throughout the document for consistency and to clarify that there is only one protocol and software program with this system.	10/7/16	NRC Action	Closed			10, 0, 0
51	For the NorthStar Guidance Subcommittee: The Committee recommended that the manufacturer's procedures be reviewed and incorporated into the Licensing Guidance itself.	10/7/16	NRC Action	Closed			10, 0, 0
52	For the NorthStar Guidance Subcommittee: The Committee recommended that the term "higher than expected" be defined in terms of a maximum specific exposure or exposure-rate limit which a survey meter should be capable of measuring.	10/7/16	NRC Action	Closed			10, 0, 0

2017 ACMUI RECOMMENDATIONS AND ACTION ITEMS

	ITEM	DATE	STATUS	
1	The Committee requested that the recommendations and actions pertaining to the Part 35 rulemaking be reviewed during the fall 2017 ACMUI neeting and that additional time be provided to review each item.	4/26/2017	NRC Action	*Pending*
8	The Patient Intervention Subcommittee will amend its Subcommittee Report and will report at the ACMUI fall 2017 meeting or by teleconference to discuss their amended report.	4/27/2017	ACMUI Action	Open
12	The NRC staff will engage in discussions with the OAS to find a way to centralize event reporting from the Agreement States.	9/11/2017	NRC Action	Open
13	The ACMUI recommended that the NRC establish a program allowing a medical use licensee to evaluate MEs as described in 10 CFR 35.3045, in NRC 10 CFR 35.1000 licensing guidance, and in 10 CFR 35.3047 with an approved patient safety program.	9/11/2017	NRC Action	Open

14	The ACMUI recommended that NRC licensees with an NRC-approved patient safety program will continue to report medical events as required with the following conditions: (1) The NRC will not include this event notification in the Event Notification Report posted on its website. If this is not possible, the ME notification posted on the website will leave the licensee information and location anonymous. (2) The NRC will not conduct a reactive inspection of the ME unless the event results or will result in death, unintended permanent harm, or unintended significant temporary harm for which medical intervention was or will be required to alleviate the harm or reduce radiation effects. (3) The medical use licensee will write a report available for the next NRC inspection describing the event cause and corrective action taken. (4) NRC will develop, with ACMUI advice, new temporary inspection procedures for NRC review of licensee patient safety event reports, and will evaluate, with ACMUI advice, need to change enforcement manual procedures regarding MEs to support a test of this program.	9/11/2017	NRC Action	Open

15	The ACMUI recommended that NRC should test out this program with two large medical centers, two community hospitals, two rural hospitals, and two patient clinics for a year, evaluating the ME reports with the ACMUI. During this test period, the NRC, with advice from the ACMUI, should do the following: (1) Develop the minimum criteria for patient safety program reviews; (2) Assess how this change in ME reporting impacts the NRC's ability to protect patient health and to minimize danger to the patient's life; and (3) Evaluate the different types of patient safety programs in how lessons learned from their patient safety incident reviews are shared with the medical community.	9/11/2017	NRC Action	Open
16	The ACMUI recommended that after completion of the test year, the NRC should consider opening the program to all NRC medical use licensees who request approval of their patient safety program, and to Agreement States who request to implement the program with their medical licensees.	9/11/2017	NRC Action	Open
17	The ACMUI recommended that the NRC redefine its perspective of patient safety to be different from occupational safety and from public safety.	9/11/2017	NRC Action	Open
18	The ACMUI recommended that NRC partner with the Department of Health and Human Services (HHS), specially the Agency for Healthcare and Research and Quality (AHRQ) , and ACMUI to develop a national database taxonomy specific for reporting patient events involving medical use of byproduct material.	9/11/2017	NRC Action	Open

19	The ACMUI recommended that the NRC Update its Medical Use Policy Statement and 10 CFR 35 event reporting regulations for patient safety programs to verify the active involvement of the licensee's patient safety program review of medical errors and reporting of reviews to the national patient safety database.	9/11/2017	NRC Action	Open
20	The ACMUI endorsed the Medical Event Reporting and Impact on Medical Licensee Patient Safety Culture Draft Report, as amended to support the concept of the pilot program with the total number of sites and duration to be determined at a later date and to include the Patient Intervention Subcommittee recommendations as an addendum .	9/11/2017	ACMUI Action	Open
21	The ACMUI will hold a public teleconference in the near future to discuss the amended Nursing Mothers Guidelines Subcommittee Report. Amendments will include, but are not limited to: (1) a suggested time frame for providing written and oral instructions to patients who will stop breastfeeding altogether and (2) consideration to revise the radionuclides to be non-pharmaceutical specific.	9/11/17	ACMUI Action	Closed
22	The ACMUI commented (1) that the literature review was thorough and the model calculations sound; and (2) the current dose-based approach to assessing patient releasability validated as more protective of public safety than the activity-based approach.	9/11/17	ACMUI Action	Closed

23	The ACMUI recommended that the current 5-mSv (500-mrem) and 1-mSv (100-mrem) projected dose limits for family members and the general public, respectively, should remain a per-event limit and are appropriate for all potentially exposed cohorts, including pregnant women and children, and all radionuclide administrations.	9/11/17	NRC Action	Closed
24	The ACMUI recommended that the 1-mSv (100-mrem) dose limit for requiring patient safety instructions should remain in place.	9/11/17	NRC Action	Closed
25	The ACMUI commented that (1) the assumption in regulatory guidance that the internal dose contribution is negligible has been validated; (2) other assumptions and methods in regulatory guidance are excessively conservative NCRP Report No 155; and (3) a patient staying at a hotel following radionuclide therapy is not a widespread practice and is unlikely to result in doses to workers and others > 1 mSv (100 mrem).	9/11/17	ACMUI Action	Closed
26	The ACMUI recommended that instructions must be provided to the patient well in advance of a planned therapy (ie not on the day of administration), without compromising patient care. Specification of a regulatory time interval for pre-therapy instructions is not recommended --> NCRP Report No 155.	9/11/17	NRC Action	Open

27	The NRC recommended that the NRC should consider updating Appendix U (NUREG 1556) to reference Regulatory Guide 8.39 rather than eliminating 8.39 or maintaining two separate guidance documents.	9/11/17	NRC Action	Open
28	The ACMUI endorsed the Patient Release SECY Paper Subcommittee Report.	9/11/17	ACMUI Action	Closed
29	The ACMUI will hold a public teleconference in the near future to discuss the amended Physical Presence Requirements for the Leksell Gamma Knife Icon Subcommittee Report. Amendments will include (1) the distinction between "an" or "the" AU or AMP;" (2) AU presence for re-initiation of procedure following interruption; (3) possible incorporation of changes to the physical presence requirements for the Leksell Gamma Knife Perfexion; and (4) whether the physical presence requirements will be limited to the frame-based or frameless-based option for the Leksell Gamma Knife Icon.	9/12/17	ACMUI Action	Closed
30	The Committee tentatively scheduled the spring 2018 ACMUI meeting for March 1-2, 2018. The back-up dates are March 14-15, 2018. The final meeting date is subject to Commission availability.	9/12/17	ACMUI Action	Closed

	ITEM	DATE	STATUS		Assigned	1st/2nd	Vote
1	The ACMUI recommended that there be no breast feeding cessation for ^{11}C, ^{13}N, ^{15}O, and ^{82}Rb; a 12-hours cessation for ^{18}F-labeled and 68Ga-labeled; a 24-hours cessation for ^{99m}Tc-labeled; 7-days cessation for ^{123}I-NaI and ^{111}In-leukocytes; 14 days cessation for ^{201}-Tl-chloride; 28 days cessation for ^{67}Ga and ^{89}Zr; 35 days for ^{177}Lu, diagnostic; and total stop of breastfeeding for ^{131}I-NaI, ^{177}Lu, therapeutic, ^{223}Ra and all alpha emitters.	2/15/2018	NRC Action	Open	Sophie		
2	The ACMUI endorsed the Nursing Mother Guidelines for the Medical Administration of Radioactive Materials Subcommittee Report, as amended to: (1) include recommended cessation periods for both 100 and 500 mrem limits; (2) acknowledge benefits of breastfeeding; (3) incorporate corrections as needed for gamma ray constants; (4) convert the units from conventional to SI units; and (5) correct references.	2/15/2018	ACMUI Action	Open	Sophie	Metter/Palestro	9, 0, 0
3	The ACMUI recommended that the AU be physically present during the initiation of all Leksell Gamma Knife Icon treatments. However, the AU could be present in the department (defined as a two minute walk to the console area) during treatment but is immediately available to come to the treatment room. If there is an interruption of treatment secondary to medical or mechanical issues, the AU must return to the console prior to reinitiation.	2/15/2018	NRC Action	Open	Sophie		
4	The ACMUI recommended as a best practice that appropriately trained nursing or auxiliary staff be present at the console to respond to any immediate medical needs.	2/15/2018	ACMUI Action	Open	Sophie		
5	The ACMUI endorsed the Physical Presence Requirements for the Leksell Gamma Knife Icon Subcommittee Report.	2/15/2018	ACMUI Action	Open	Sophie	Suh/Zanzonico	9, 0, 0

Open Forum

NO HANDOUT

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Status of Medical Events FY 2017

Donna-Beth Howe, Ph.D.
Medical Radiation Safety Team
March 7, 2018

1

Medical Events

The dose threshold for diagnostic events precludes reportable events most years.

Each year there are approximately 150,000 therapeutic procedures performed utilizing radioactive materials.

2

Medical Events 2012-14

- **48 Medical events reported - FY 2012**
- **43 Medical events reported - FY 2013**
- **46 Medical events reported - FY 2014**

	FY12	FY13	FY 14
35.200	2	0	1
35.300	2	2	3
35.400	15	15	5
35.600	13	10	10
35.1000	20	16	27

3

Medical Events 2015-17

- **57 Medical events reported - FY 2015**
- **50 Medical events reported - FY 2016**
- **42 Medical events reported - FY 2017**

	FY15	FY16	FY17
35.200	3	4	0
35.300	8	4	4
35.400	9(10)	6(18)	7
35.600	17	6	8(14)
35.1000	20(31)	30	23

4

Medical Events 2017

35.300 Medical events 4

Iodine 131	3
Radium 223	1

5

35.300 Medical Events (cont.)

Iodine-131 3

- **Administered 2 mCi when none was prescribed.**
  - Prescribed parathyroid test but received thyroid scan.
  - I-131 ordered without written directive.
  - Electronic ordering and records system used without confirmation of the order prior to administration.
  - Thyroid received 1,630 cGy.
  - Modified procedures, confirm dosage orders, and re-trained personnel.

6

35.300 Medical Events (cont.)

Iodine-131 cont.

- **Administered 20.2 mCi instead of 30 mCi in written directive.**
  - Written Directive was incorrect.
  - Intended dose was given.
  - Three individuals now review the Written Directive for accuracy before signing and administration.

7

35.300 Medical Events (cont.)

Iodine-131 cont.

- **Administered 106 mCi instead of 150 mCi.**
  - Dosage delivered in two capsules.
  - Patient shook the vial contents into her mouth, only swallowed one capsule, other left in vial.
  - Discovered when capsule returned to the pharmacy.

8

35.300 Medical Events (cont.)

Ra-223 dichloride 1

- **Administered 176.1 µCi instead of 108.4 µCi.**
  - Wrong patient.
  - Two patients scheduled for Ra-223 treatment on the same day.
  - Doses properly labeled with patient names on the lead pigs and syringes.
  - Wrong syringe used without checking patient identity.
  - Added a timeout, dosing physician verifies identity of the patient and prescribed dose in the written directive.

9

Medical Events 2017

35.400 Medical events 7

Prostate	7
One licensee 2 reports	2
Human error	
Anatomy	
Wrong site	1
Used previous activity	1
Larger then pre plan or swelling	3

10

35.400 Medical Events

Prostate **7**

- **One licensee, 2 separate reports**
- Case 1 - Patient received 62% of the prescribed D90 dose of 14,500cGy.
  - No root cause but attributed to human error.
  - Some seeds may have migrated post implant.

11

35.400 Medical Events

- Case 2 - Patient received 78% of the prescribed D90 dose of 14,500cGy.
  - Caused by patient anatomy.
  - Identified during post-implant CT scan and subsequent dosimetric analysis.
  - Delay in reporting to State due to communication breakdown and inadequate procedures.

12

35.400 Medical Events cont.

- **Patient received 2,760 cGy instead of 11,00cGy 74.9% less than prescribed.**
  - Wrong site.
  - Estimated dose to the urethra at 2,602 cGy (rad), the rectum at 861 cGy, and the penile bulb at 8,689 cGy.
  - human error - additional training to personnel and improved supervision.

13

35.400 Medical Events cont.

- **Patient received 157.81% of the prescribed D90 dose of 12,500cGy - Pd103 seeds.**
  - Failed to enter correct activity per seed into physics spreadsheet that contained a value from the previous calculation.
  - Did not perform independent verification of treatment data.
  - New action: secondary hand calculation, require use of blank spreadsheet template, and verbal time-out to verify key parameters prior to treatment.

14

35.400 Medical Events cont.

- **Prescribed 14,400 cGy received 73% of the dose.**
  - 18% increase in prostate size compared to the pre-plan and the planned intentional cooler coverage near the patient's rectum.
  - Discovered during a routine audit conducted by a medical physicist.

15

35.400 Medical Events cont.

- **Prescribed 14,500 cGy received 10,000 cGy - 69% of the dose.**
  - Administered 12/7/2016, event discovered on 12/8/2016.
  - Second treatment on 12/9/2016 - eight more seeds implanted.
  - Post-operative swelling and seed migration
  - Perform post-implant imaging sooner to minimize the effect of swelling of the prostate gland and possible migration of the seed

16

35.400 Medical Events cont.

- **Prescribed 14,500 cGy received 10,353 cGy - 71% of the dose.**
  - Order additional seeds beyond what the pre-plan requires.
  - Perform post-implant x-ray and ultrasound to determine if/where additional seeds could be placed.

17

Medical Events 2017

35.600 Medical events		**8(14)**
HDR (9 patients)		
• Gynecological(14)		7
Software Issue (9 patients)	2	
Wrong site	4	
Equipment failure	1	
Gamma Knife		1

18

35.600 HDR Events (cont.)

Gynecological 7 (14)

- **Generic Software issue (4 patients)**

– Oncentra software versions 4.5, 4.5.1, and 4.5.2 issue with source step size with ring.
– Source step size of 5 mm instead of 2.5 mm.
– Dose to unintended site 2,800 cGy to 1,400 cGy.
– Dose to the unintended site expected too be 126 to 175 cGy per fraction.
– Elekta notified software users of problem with ring.

19

35.600 HDR Gynecological (cont.)

- **Generic Software issue cont. (5 patients)**

– Oncentra software versions 4.5.2 issue with source step size with ring of 5 mm instead of 2.5 mm.
– Dose to treatment site 24.46%, 21%, 31.96%, 25.58%and 20.89% less than intended.
– Did not calculate dose to the unintended site.
– Some source paths extended beyond planned endpoint and started on a return path back into the lower vagina.
– Some tissue protection by fluid-filled sleeve that provided some shielding and displacement.

20

35.600 HDR Gynecological (cont.)

- **Wrong site** **4**

– 5 cm site received 500 cGy
– Wrong software orientation selected.
– Oncentra treatment planning – must choose if the treatment catheters are modeled from the tip or connecting end of the catheter.
– Catheter in the tip end mode which was incorrect.
– Provide additional training to personnel.

21

35.600 HDR Gynecological (cont.)

- **Wrong Site cont.**

– Capri applicator inserted into the patient's rectum instead of vagina on 2nd of 5 fractions.
– Treatment site received prescribed dose of 350 cGy (rad) during the second treatment.
– Radiologist confirmed the patient's rectum had been treated.

22

35.600 HDR Gynecological (cont.)

- **Wrong site cont.**
- 5 cm site received 500 cGy
- first two tandem and ovoid treatments were delivered as prescribed
- Incorrect tandem applicator length of 119.8 cm was entered into the treatment planning system for third fraction instead of the prescribed 131.9 cm.

23

35.600 HDR Gynecological (cont.)

- **Wrong site cont.**
- Received 700 cGy
- Physicist determined inserted length of the transfer guide tube was 7.5 cm shorter than intended.
- The transfer tube was deformed and added pressure needed to fully insert it into the applicator.
- Removed the transfer guide tube from service, got different design.
- Counseled staff on the event.

24

35.600 HDR Gynecological (cont.)

- **Equipment failure.**
  - Received 6.4% of prescribed 500 cGy dose during the 1st of 5 fractions.
  - Five separate interlocks were tripped in 1st fraction.
  - fluid in the catheter may have contaminated the source and afterloader unit.

25

35.600 Gamma knife 1

Gamma Knife Model C.

- **Prescribed 2000 cGy received 1540 cGy to brain lesion**
  - Three of five shots delivered.
  - Couch retracted from the treatment position due to a clutch malfunction.
  - Patient was released - repairs completed in six hours.
  - Patient elected to not return.

26

Medical Events 2017

35.1000 Medical events		**24**
Intervascular Brachytherapy	**1**	
Y-90 Microspheres	**23**	
Therasphere ®	15	
SirSphere ®	8	

27

35.1000 Medical Events

Intravascular Brachytherapy **1**

- Prescribed dose of 1,840 cGy (rad) for in-stent restenosis in two dwell positions.
- Received 50% of dose – one position treated.
- Source train stuck - not retract to the afterloader.
- Deformation 7.3 cm distal to the strain relief - located outside the patient.
- Compression of the catheter during a challenging advancement into a commonly tortuous vessel (left internal mammary artery).

28

35.1000 Medical Events

Y-90 Microspheres		23
Therasphere ®		15
– Over dose	3	
– Wrong site	2	
– Kinked catheter	4	
– Cracked catheter	1	
– Partial Obstruction	1	
– Leaking connection	2	
– Slow infusion	1	
– Reflux to other lobe	1	

29

35.1000 Therasphere® Y-90 Events

Overdose **3**

- **Prescribed 11,000 cGy administered 54,000 cGy - right lobe**
  - Wrong calibration date (6/11/2017 instead of 6/4/2017) used in ordering.
  - Used dose calibrator – did not question results.
  - Written directive not prepared and not signed before administration.
  - Shunting lung dose 2,576 cGy (rad), - intended 524 cGy (rad).
  - About 6 months later no clinically significant symptomatic complications.

30

35.1000 Y-90 Therasphere® (cont.)

Overdose cont.

- **Prescribed 34,000 cGy administered 80,800 cGy – liver volume.**
  - Administered before microspheres decayed to the prescribed activity - Scheduling nurse used the pre-treatment plan instead of the final treatment plan.
  - The physicist's pre-treatment calculations and time-out failed.

31

35.1000 Y-90 Therasphere® (cont.)

Overdose cont.

- **Prescribed 34,000 cGy administered 80,800 cGy – liver volume.** (cont.)
  - Spreadsheet to calculate patient dose modified to check the administration vial's calibration activity and date versus the prescribed activity and procedure date.
  - The time-out procedure modified to confirm the proper activity prior to administration.

32

35.1000 Y-90 Therasphere® (cont.)

Overdose cont.

- **Prescribed activity 1.05 GBq (28.37 mCi) - administered activity was 2.05 GBq (55.35 mCi).**
  - Human error in converting activity from GBq to mCi.
  - Corrective actions - procedure modifications, written directive revisions, and software updates to assist in unit conversions.

33

35.1000 Y-90 Therasphere® (cont.)

Wrong site **3**

- **Prescribed 6,000 cGy – administered 4,860 cGy (rad) to the left lobe and 3,650 cGy (rad) to the right lobe.**
  - Challenging anatomy - a narrow window just distal to vasculature suppling right lobe – reflux to right lobe.
  - Verified catheter position multiple ways before administration - no apparent complications.
  - Bremsstrahlung imaging showed microspheres in both lobes.

34

35.1000 Y-90 Therasphere® (cont.)

Wrong site **3**

- **Prescribed 6,000 cGy – administered 4,860 cGy (rad) to the left lobe and 3,650 cGy (rad) to the right lobe.** (cont.)
  - Movement of the catheter from unnoticed patient movement (breathing) or angiographically undetected reflux caused by the difference in flow dynamics of the microspheres, contrast agent and Tc-99M macro-aggregated albumin (MAA).

35

35.1000 Y-90 Therasphere® (cont.)

Wrong site cont.

- **Two separate segments in the right lobe prescribed 25.6 mCi to the small segment and 64.3 mCi to the large segment.**
  - Later discovered only 10.27 mCi was ordered for the large segment.
  - Each dose needed different calibration dates.
  - Contrary to vendor guidance, the licensee used one order sheet for the two doses with one calibration date

36

35.1000 Y-90 Therasphere® (cont.)

Wrong site cont.

- **Two separate segments in the right lobe prescribed 25.6 mCi to the small segment and 64.3 mCi to the large segment.** (cont.)
  - Process involved several hand-offs, reviews, and verifications by different providers using different source documents - inconsistency between the written directive and the order and assay data was not identified prior to patient treatment.

37

35.1000 Y-90 Therasphere® (cont.)

Wrong site cont.

- **Prescribed 47.03 mCi to the left lobe - administered 46.22 mCi to right lobe (right lobe to be treated one month later).**
  - Interventional radiologist and radiation oncologist authorized user signed off on the planned activity for the left lobe via the left hepatic artery - the authorized user completed the written directive.
  - Interventional radiologist put catheter in patient's right hepatic artery for right lobe – human error confused about later treatment of right.

38

35.1000 Y-90 Therasphere® (cont.)

Wrong site cont.

- **Prescribed 47.03 mCi to the left lobe - administered 46.22 mCi to right lobe (right lobe to be treated one month later).** (cont.)
  - In operating room time-out all parties confirmed the procedure, and treatment was administered.
  - Modified written directive time out procedure.

39

35.1000 Y-90 Therasphere® (cont.)

Kinking **4**

- **Prescribed 146.51 mCi –administered 11.35 mCi – liver dose of 970 cGy (rad) and lung dose from shunting of 101 cGy (rad).**
  - Thought slow injection flowrate, dent in the outlet tubing from a pinch-clamp, and over-tightening of the Touhy-Borst Y-adaptor caused sedimentation of the microspheres in the delivery system.
  - The manufacturer's inspection a small mass of microspheres inside the dose vial and within the outlet tubing, multiple locations with kinks, no septum fragments or other obstructions were observed, no evidence that the Tuohy fitting was over tightened.

40

35.1000 Y-90 Therasphere® (cont.)

Kinking cont.

- **Prescribed 12,000 rad – administered 6,000 rad.**
  - A kinked delivery catheter prohibited complete microsphere administration.
- **Prescribed 51.57 - administered 39.07 mCi to the right lobe.**
  - Residual activity 12.5 mCi remaining in the delivery device.
  - Visual kink at the hub of the catheter was identified.

41

35.1000 Y-90 Therasphere® (cont.)

Kinking cont.

- **Prescribed 46 mCi administered 20 mCi.**
  - Two separate liver segments.
  - Second acrylic jar contained 56% of the microspheres intended for the patient's second liver segment.
  - Protocols for dose preparation, box construction, and dose administration were followed.
  - Minor resistance during the flush of the stretched out micro-catheter.
  - Possible micro-catheter had a kink and be able to flush contrast and saline through it, but have microspheres clog it.

42

35.1000 Y-90 Therasphere® (cont.)

Cracked catheter 1

- **Prescribed two doses with a total activity of 54 mCi to the right and left lobes - administered 21.62 mCi**
  - first dose and second administrations through the radial artery of the left hand using a microcatheter (Marksman).
  - Post radiation surveys both about 5 mR/hr for the microsphere vial - AU assumed first was from contaminated cloth but recognized second meant two under doses.
  - Visual inspection of the microcatheter revealed a crack - the crack was determined to be the cause of the event.

43

35.1000 Y-90 Therasphere® (cont.)

Partial obstruction 1

- **Prescribed 47.88 mCi – administered 13.91mCi.**
  - Thought treatment went as planned, no issues with viewed flow before administration, no increased resistance was noted and could flush the line post administration.
  - Discovered during survey of waste and performing the dose assessment.

44

35.1000 Y-90 Therasphere® (cont.)

Partial obstruction 1

- **Prescribed 47.88 mCi – administered 13.91mCi.** (cont.)
  - Thought partial obstruction in catheter or line connecting the microsphere vial to the catheter, vasculature was complicated and may have resulted in movement of the micro-catheter slightly forward from initial placement.
  - Greater than usual amount of saline in the overflow vial.

45

35.1000 Y-90 Therasphere® (cont.)

Leaking catheter connection 2

- **Prescribed 11.87 mCi – administered 8.34 mCi.**
  - During treatment liquid leaking from the connection between the e-line and the catheter placed in the patient was noted.
  - Treatment stopped and started decontamination - patient's thigh and groin, skin dose was calculated to be 1.1 μSv (0.11 mrem).
  - Incident due to human error - poor connection between the e-line and the patient's catheter.

46

35.1000 Y-90 Therasphere® (cont.)

Leaking catheter connection cont.

- **Prescribed 25.95 mCi – administered 8.99 mCi.**
  - Leak occurred while connecting the infusion line from the microsphere vial to the microcatheter.
  - Physician simultaneously unclamped the administration line while trying to connect it to the microcatheter.
  - Physician assumed the leaking fluid only contained saline and proceeded with administration.
  - Leak caused contamination of the administration area, which was immediately decontaminated.

47

35.1000 Y-90 Therasphere® (cont.)

Slow injection rate 1

- **prescribed 175.7 mCi – administered 43.24 mCi.**
  - Slow injection rate to prevent reflux into adjacent gastric artery that could not be coil embolized.
  - Completed administration, three saline flushes, verified digital radiation dosimeter was reading 0.0, indicating that the microspheres had left the vial.
  - Microspheres collected in the catheter outside of the patient.

48

35.1000 Y-90 Therasphere® (cont.)

Slow injection rate **1**

- **prescribed 175.7 mCi – administered 43.24 mCi.** (cont.)
  - External experts confirmed that a slow injection rate can result in an event like this and RSO identified catheter backup in another slow injection rate administration.

49

35.1000 Y-90 Events (cont.)

SirSphere ® 8

- Labeled vial shield not vial 1
- Low activity administration 3
- High activity clogging 1
- Clogging issues 3
  - Needle 1
  - Catheter defect 1
  - Kinked 1

50

35.1000 Y-90 SirSphere ® (cont.)

Labeled vial shield not vial 1

- **Prescribed 2.453 mCi to small lesion and 22.077 mCi to large lesion - administered 22.077 mCi to small lesion.**
  - Prepared two vials, labeled each vial shield, did not label the vials.
  - Provided vial with 22.077 mCi for small lesion realized mistake when started large lesion.
  - Require time-out, label both the vial and vial shield, read labels three times before administration.

51

35.1000 Y-90 SirSphere ® (cont.)

Low activity administration 3

- **Prescribed 6.49 mCi to 2 segments - administered 4.46 mCi.**
  - Activity in residual waste - stasis was not reached during administration.
  - Procedure modifications, form modifications, written directive adjusted to tighten up the dose drawn to match 100% of the prescribed dose, and committed to have an AMP physician present to observe low activity administrations.

52

35.1000 Y-90 SirSphere ® (cont.)

Low activity administration cont,

- **Prescribed 5.49 mCi - administered 4.07 mCi.**
  - Cause of the event was the amount of activity delivered; the relatively low prescribed dose made the residue look comparatively large.
  - Another doctor will supervise the remainder of the administrating doctor's cases - part of the requirements for obtaining authorized user status.

53

35.1000 Y-90 SirSphere ® (cont.)

Low activity administration cont,

- **Prescribed 4.05 mCi - administered 3.14 mCi.**
  - Radiation survey revealed residual activity of 1.06 mCi remained in the treatment device.
  - The use of small doses will be carried out after greater scrutiny and review.

54

35.1000 Y-90 SirSphere ® (cont.)

High activity clogging 1

- **Prescribed 84.12 mCi - administered 59.8 mCi.**
  - Tubing became clogged and the entire activity could not be administered.
  - Due to a large dose of microspheres - increased amount of microspheres in the system clogged the micro-catheter towards the patient.

55

35.1000 Y-90 SirSphere ® (cont.)

Clogged needle 1

- **Prescribed 32.97 mCi - administered 8.2 mCi.**
  - Occlusion of the vial delivery C needle due to clumping of the microspheres.
  - Intended to return to manufacturer but discarded after activity decayed to background.
  - Educating the administrator of the microspheres on how to clear the clogged needle, which is to reverse the valve for flushing purposes.

56

35.1000 Y-90 SirSphere ® (cont.)

Catheter defect 1

- **Prescribed 12.16 mCi - administered 5.64 mCi.**
  - AU and interventional radiologist noticed a strong resistance as they pushed on the syringe.
  - The micro-catheter was pulled from the patient - a very small defect was observed.
  - Cause of the microsphere blockage was a defect in the micro-catheter.
  - MedWatch FDA Adverse Event form completed.

57

35.1000 Y-90 SirSphere ® (cont.)

Kinked catheter 1

- **Prescribed 40.4 mCi - administered 21.5 mCi.**
  - Think patient inhaled deeply and created a kink in the catheter.
  - The first three or four aliquots were delivered before the plunger met resistance.
  - Kinked catheter was confirmed by PET/CT imaging of the administration set and vial.

58

Acronyms

- AU – Authorized User
- cGy – centiGray
- FY – Fiscal Year
- GBq – Giga Becquerel
- HDR – High Dose Rate Remote Afterloader
- I-131 – Iodine-131
- I-124 – Iodine-124
- Ra-223 –Radium-223
- mCi – millicurie
- µCi – microcurie
- MBq – Mega Becquerel

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QUESTIONS?

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NRC Staff Response to ACMUI Safety Culture Recommendations

Doug Bollock
ACMUI Spring Meeting
March 7, 2018

Agenda

- Review the ACMUI recommendations from ACMUI report "*Medical Event Reporting and Impact on Medical Licensee Patient Safety Culture*"
- Provide the NRC staff's responses to the ACMUI recommendations

ACMUI Recommendations

- On September 11, 2017 the ACMUI unanimously approved ACMUI report "*Medical Event Reporting and Impact on Medical Licensee Patient Safety Culture" which included their recommendations.*

3

NRC Responses

- Meeting the purpose of Medical Event Reporting
- Limitations to conducting a pilot program utilizing PSOs
- Changing criteria for an NRC reactive inspection

4

Acronyms

- NRC- U.S. Nuclear Regulatory Commission
- ACMUI- Advisory Committee on the Medical Uses of Isotopes
- PSO- Patient Safety Organization
- ME- Medical Event

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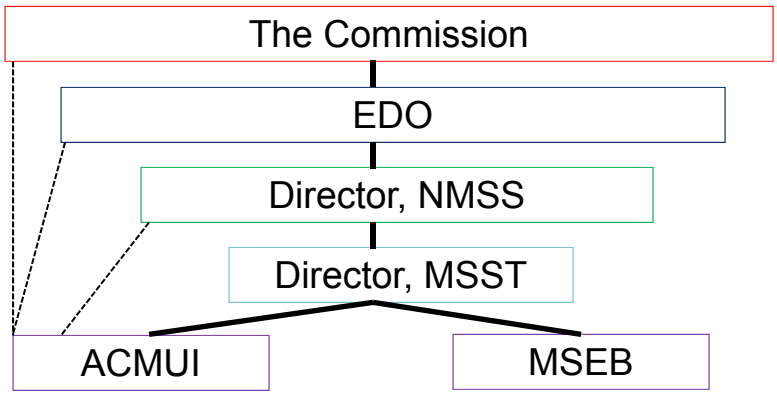
Committee Reporting Structure

Sophie Holiday, ACMUI Coordinator
Medical Radiation Safety Team
March 7, 2018

Outline

- **Current Reporting Structure**
- **Annual Review**
- **Meetings**
- **Discussion**

Current Reporting Structure



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Annual Review

- **In September 2012, the ACMUI recommended to have an annual review of reporting structure.**
- **This is the eighth annual review.**

4

Meetings

Two meetings at Headquarters each year

- **March/April**
- **September/October**

Approximately 2-3 teleconferences (as needed)

5

Discussion

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Points of Contact

- **Kevin Williams – Acting MSST Director**
  - **301-415-3340; Kevin.Williams@nrc.gov**
- **Douglas Bollock – Designated Federal Officer**
  - **301-415-6609; Douglas.Bollock@nrc.gov**
- **Sophie Holiday – ACMUI Coordinator**
  - **301-415-7865; Sophie.Holiday@nrc.gov**

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Acronyms

- **EDO – Executive Director for Operations**
- **MSST – Division of Materials Safety, Security, States, and Tribal Programs**
- **MSEB – Medical Safety and Event Assessment Branch**
- **NMSS – Office of Nuclear Material Safety and Safeguards**

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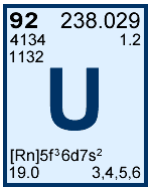
Worldwide Supply and the Domestic Production of Molybdenum-99 (^{99}Mo)

Richard L. Green, R.Ph, BCNP

March 7, 2018

^{235}U Fission Produces HSA ^{99}Mo

- **Starts with the enrichment of ^{235}U**
  - **Abundance in nature = 0.7%**
- **Enrichment level trigger point**
  - **Low enriched uranium (LEU)**
    - **<20%**
  - **High enriched uranium (HEU)**
    - **>20%**
- **<u>Current HSA</u> ^{99}Mo production involves**
  - **Reactor fuel (LEU or HEU)**
  - **Targets (LEU or HEU)**



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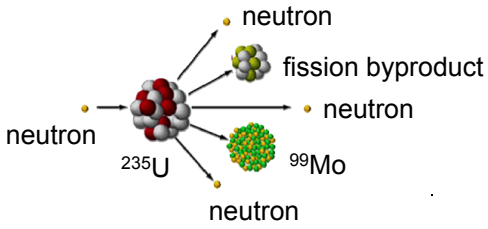
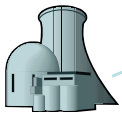
Current Fission ^{99}Mo Supply Chain




GE


Lantheus


Curium


Reactors


Processors

Fission ^{99}Mo HSA Generators

3

Reactors Producing HSA ^{99}Mo

Reactor	Location	Commissioning Date	Fuel Type	Target Type	Global ^{99}Mo Processor
HFR	Petten, Netherlands	1961	LEU	LEU	Curium / IRE
BR2	Mol, Belgium	1961	HEU	HEU	Curium / IRE
SAFARI	Pelindaba, South Africa	1965	LEU	LEU	NTP
MARIA	Otwock-Swierk, Poland	1974 1993 rebuilt	LEU	LEU	IAE-Polatom / Curium
LVR-15	Rez, Czech Republic	Mid 1950's	LEU	HEU	Czech Nuclear Research Institute / IRE
OPAL	Lucas Hts., Australia	2007	LEU	LEU	ANSTO

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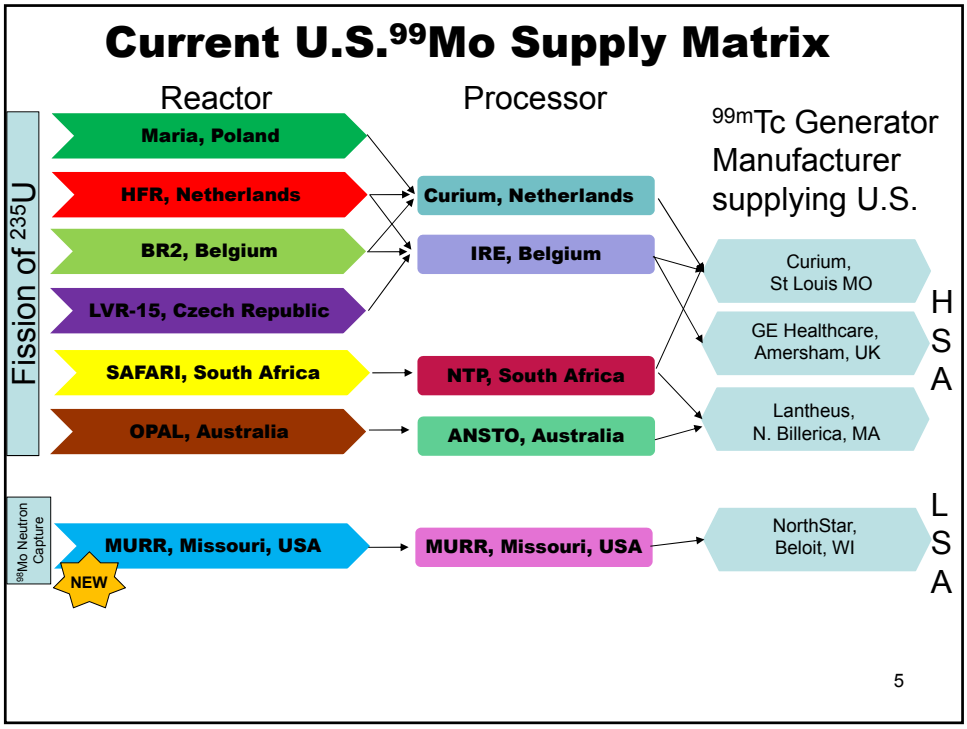
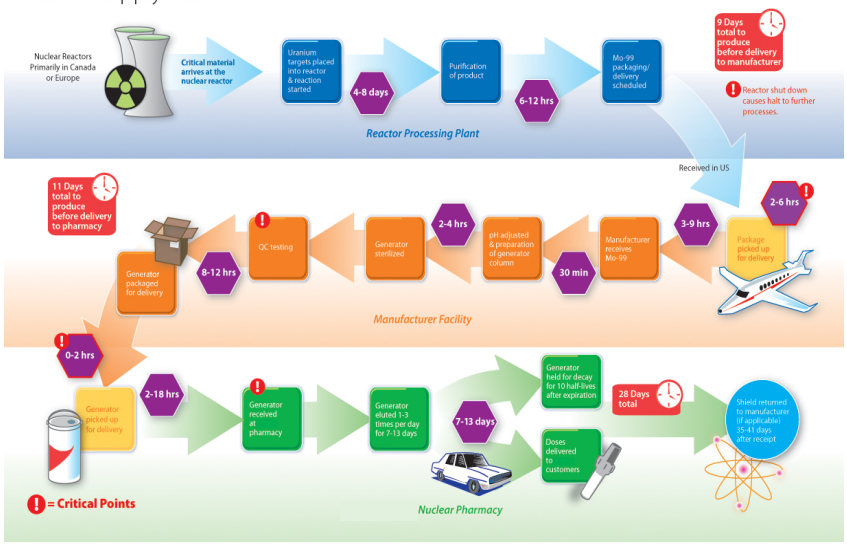


American Medical Isotopes Production Act of 2009

- Provides $163 million to DOE to support Mo-99 production with LEU
- Prohibits export of HEU for medical isotopes from US after 7 years (provision to extend 3 yrs)
- Requires NRC to report disposition of previous exports of HEU
- Allows NRC to license HEU production under certain conditions
- Requires annual reports from DOE on support of US ^{99}Mo production
- Requires a NAS study 5 years after enactment

Mo-99 supply chain



^{99m}Tc Supply Chain Challenges

Irradiator disruptions

- Extended unplanned shutdowns frequent with aging reactors
- Permanent shutdown are imminent at NRU and OSIRIS
- Permanent shutdown at HFR on horizon

$ Rising prices

- Governments taper subsidies and prices come to cover costs more fully
- Switch to LEU
- Potential supply squeeze

Industry Response

- Renovation of existing reactor/processing facilities
- New conventional reactor capacity
- New ^{99}Mo production technologies
- Improved supply chain efficiency
- Increased globalization of supply chain

Source: OECD NEA

A New U.S. ^{99}Mo Producer !

- NorthStar Medical Radioisotopes, LLC
  Beloit, WI

- 8 Feb 2018
U.S. FDA approved the first domestically-produced, non-uranium based ^{99}Mo

- A LSA, computer controlled ^{99}Mo generator system

RadioGenix SYSTEM
(technetium Tc 99m generator)

https://www.northstarnm.com/products/northstar-solutions-radiogenix-system/

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NS's Current Production Method

- **Short term – Missouri University Research Reactor (MURR), Columbia MO**
  - **Neutron Capture**
    - **^{98}Mo(n,γ)^{99}Mo**
      - **» using natural enrichment ^{98}Mo**
        - **» ~6 Ci / source vessel**

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NS's Future Production Method

- **Neutron Capture**
  - $^{98}Mo(n,\gamma)^{99}Mo$
    - » using enriched ^{98}Mo
      - » ~18 Ci / source vessel
- **Long term - linear accelerator at NorthStar facility in Beliot, WI**
  - $^{100}Mo(p,2n)^{99}Mo$

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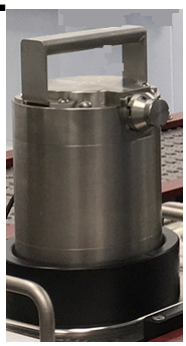
LSA ^{99}Mo Generator

- **Source vessel contains ~30 mL potassium molybdate ^{99}Mo**
- **Protocols**
  - Produce ^{99m}Tc
  - Add/change reagents
  - Add/exchange reagents
  - Sterilize system
  - Add source vessel
  - Remove source vessel
  - Add/exchange discarded material container



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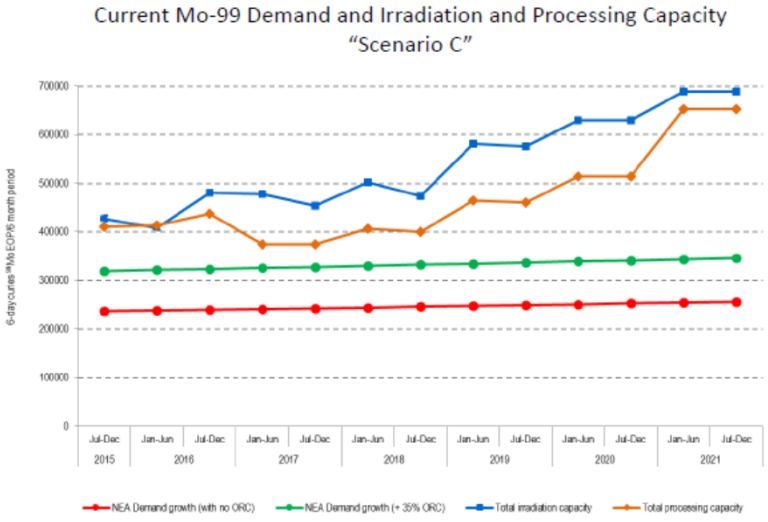
Other Potential New U.S. Producers?

- Shine Medical Technologies, Monona, WI
  - Dec 12, 2016 –awarded $10 million from the U.S. DOE/NNSA as part of a $20.9 million cooperative agreement to support the establishment of domestic, commercial production of ^{99}Mo produced without the use of HEU.
  - Feb 2018 Completed construction and taken occupancy of Building One, the first building of the SHINE medical isotope production campus. Facility will be used to house the first integrated, full-size SHINE production system

Neutrons from accelerator ⟶ U salts ⟶ ^{99}Mo

Current Processing Production & Projected Future Demand, Global, 2015 - 2020



Source: OECD-NEA Report "2016 Medical Isotope Supply Review: ^{99}Mo/^{99m}Tc Market Demand and Production Capacity Projection 2016-2021", June 2016

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Acronyms

ACMUI – Advisory Committee on the Medical Uses of Isotopes
DOE – Department of Energy
EOP – end of production
^{99}Mo – nuclide of molybdenum with 66 hour half-life, precursor of ^{99m}Tc
GTRI – Global Threat Reduction Initiative
HEU – highly enriched uranium (>20%)
HSA – high specific activity
LEU – low enriched uranium (<20%)
LSA – low specific activity
MURR – Missouri University Research Reactor
non-HEU ^{99}Mo – molybdenum 99 manufactured without the use of highly enriched uranium
NNSA – National Nuclear Security Administration
NS – NorthStar
^{99m}Tc – nuclide of technetium with 6 hour half-life, used in ~85% of diagnostic nuclear medicine imaging
^{235}U – radioactive form of uranium used to fuel reactors

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Acronyms

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NRC Medical Projects on the Horizon

Doug Bollock
ACMUI Spring Meeting
March 7, 2018

Agenda

- Discuss the major assignments currently under review by the Medical Radiation Safety Team

Major Projects

- Part 35 Rule change implementation
- Germanium/Gallium-68 Generators
- Physical Presence Requirements for Leksell Perfexion and Icon
- Yttrium-90 Microspheres
- Patient Release (Reg. Guide 8.39)
- Training and Experience paper

3

Acronyms

- NRC- U.S. Nuclear Regulatory Commission
- ACMUI- Advisory Committee on the Medical Uses of Isotopes

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ACMUI Working Prepatory Session

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Special Presentation

to

Dr. Pat Zanzonico

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Emerging Medical Technologies Commission Paper

Irene Wu

March 7, 2018

Purpose

- To provide the Commission with the NRC staff's review of the emerging medical technologies program

2

Content

- Process for reviewing emerging medical technologies
- Discussion of past, in process, and anticipated future reviews of medical technologies
- Resource estimates for the review of new technology and guidance development (non-public)

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Examples of Past Reviews

- Eckert and Ziegler GalliaPharm™ Germanium-68/Gallium-68 Pharmacy Grade Generator
- Low Activity Radioactive Seeds Used for Localization of Non-Palpable Lesions and Lymph Nodes
- Radium-223 Dichloride

4

Examples of In Process Reviews

- Yttrium-90 Microsphere Brachytherapy Sources and Devices TheraSphere® and SIR-Spheres®
- Leksell Gamma Knife® Perfexion™ and Leksell Gamma Knife® Icon™
- Lutetium-177 dotatate

5

Examples of Anticipated Reviews

- Phosphorus-32 OncoSil™ microparticles
- MASEP Infini™ cobalt-60 stereotactic radiosurgery
- GammaPod™ cobalt-60 stereotactic radiotherapy

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Acronyms

NRC – U.S. Nuclear Regulatory Commission

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Commission Meeting with the ACMUI

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Group Photo

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Thoughts on Leaving the ACMUI

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