23rd Ministerial Meeting

FNCA Forum for Nuclear Cooperation in Asia

COUNTRY REPORT

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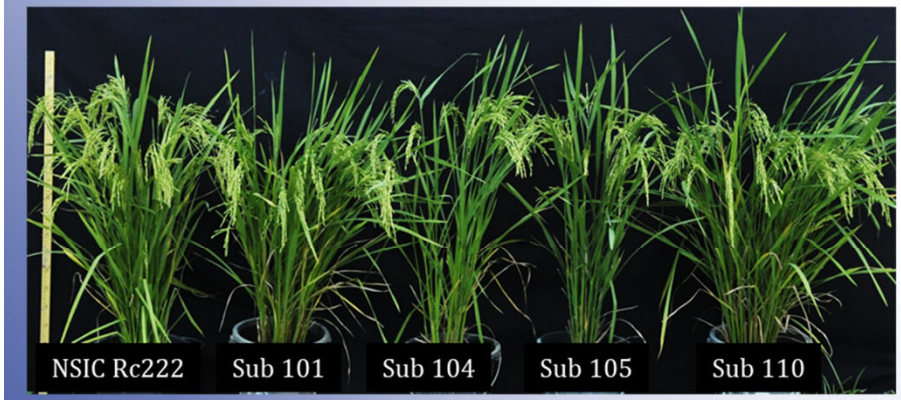
Mutation Breeding

INDUCED MUTATION TO IMPROVE PHILIPPINE RICE VARIETY NSIC Rc 222

- Induced mutation by gamma irradiation of mature seeds of NSIC 2009 Rc 222 (*Tubigan 18*), generated **five promising mutant lines with improved grain quality and tolerance to complete submergence**
- Promising lines are currently under **seed multiplication for 2023 Multi-Environment Test** in different submergence-prone locations in the country



Plant type of the promising mutant lines as compared to the original (*Tubigan 18*)

Survival (%) at 21 days after de-submergence, grain yield under non-stress (NSTR) and complete submergence (STR), and yield reduction due to complete submergence for 8 days of the promising mutant lines and checks during 2019 DS.

No.	Genotype	Survival (%)	Comparative survival (%) relative to PSB RC68	Grain Yield (t ha^{-1})			
				NSTR	STR	Reduction	
						t ha^{-1}	%
1	Submarino 1	49.1		6.160	1.392	4.768	-77.4
2	PSB Rc 68	72.2		5.647	1.688	3.959	-70.1
3	Tubigan 18	35.3		5.522	1.273	4.249	-76.9
4	Sub100	61.9*	85.7	8.644	3.089**	5.555	-64.3
5	Sub101	72.2*	100	7.935	3.961**	3.974	-50.1
6	Sub104	68.1*	94.3	8.468	4.602**	3.867	-45.7
7	Sub105	59.7*	82.7	5.880	3.806**	2.074	-35.3
8	Sub110	48.6*	67.3	4.807	4.086**	0.721	-15.0

**Significantly higher than NSIC Rc222 by Dunnett's Comparison of Means at Alpha = 0.05*
***Significantly higher than the checks by Dunnett's Comparison of Means at Alpha = 0.05*

Survived plants of Sub 101 and Sub 104 after 97 days from de-submergence

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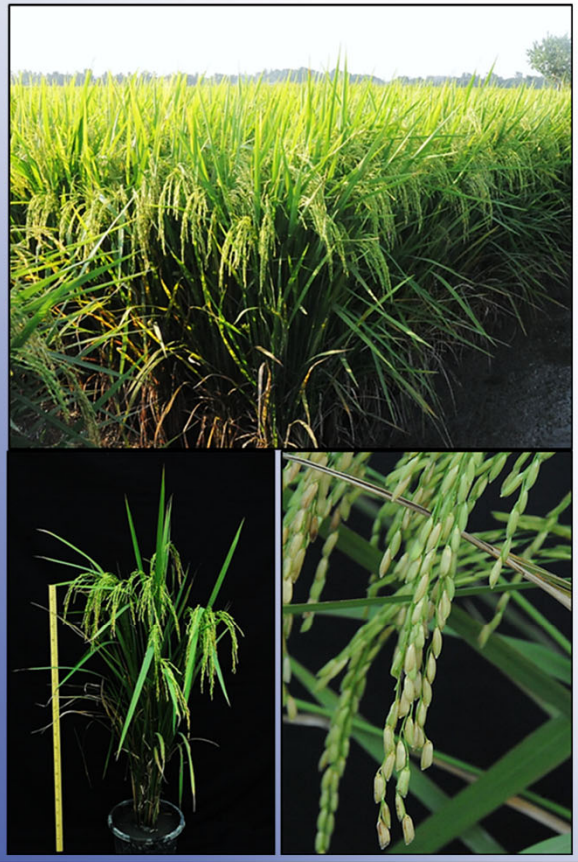
Mutation Breeding

RELEASED VARIETIES FROM *IN VITRO* MUTAGENESIS

- In 2019 and 2022, **two mutants developed from *in vitro* mutagenesis** were approved by the National Seed Industry Council (NSIC) **for cultivation and adoption in rainfed-drought and saline prone rice environments**
- Currently (2022) in **Basic Seed Production (Breeder Seed)**



NSIC 2019 Rc 572 (*Sahod Ulan 28*)

Maturity:
109 DAS

Plant Height:
99 cm

Maximum Grain yield:
4.531 tha^{-1}

Pest/Disease Resistance:
Blast, BLB, Stem borer, BPH

Head Rice Recovery:
53.4 (Grade 1)

Amylose Content:
20.9% (intermediate)

Cook Rice Texture:
Tender/Soft

Developed from *in vitro* mutagenesis of drought-tolerant upland rice variety NSIC 2002 Rc 9 (*Apo*)

NSIC 2022 Rc 686 (*Salinas 39*)

Maturity: 113 DAS

Maximum Grain yield: 4.228 tha^{-1}

Pest/Disease Resistance: blast

Cook Rice Texture: Soft

Developed from *in vitro* mutagenesis of submergence tolerant rice variety FR13A

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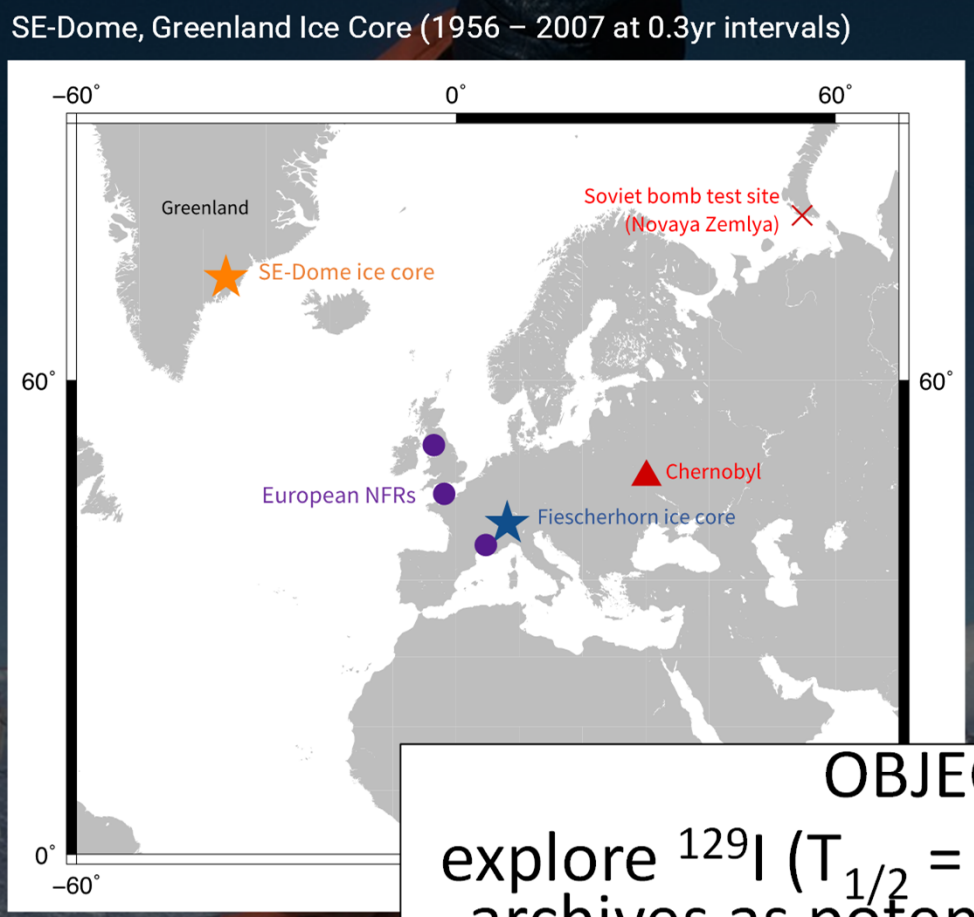
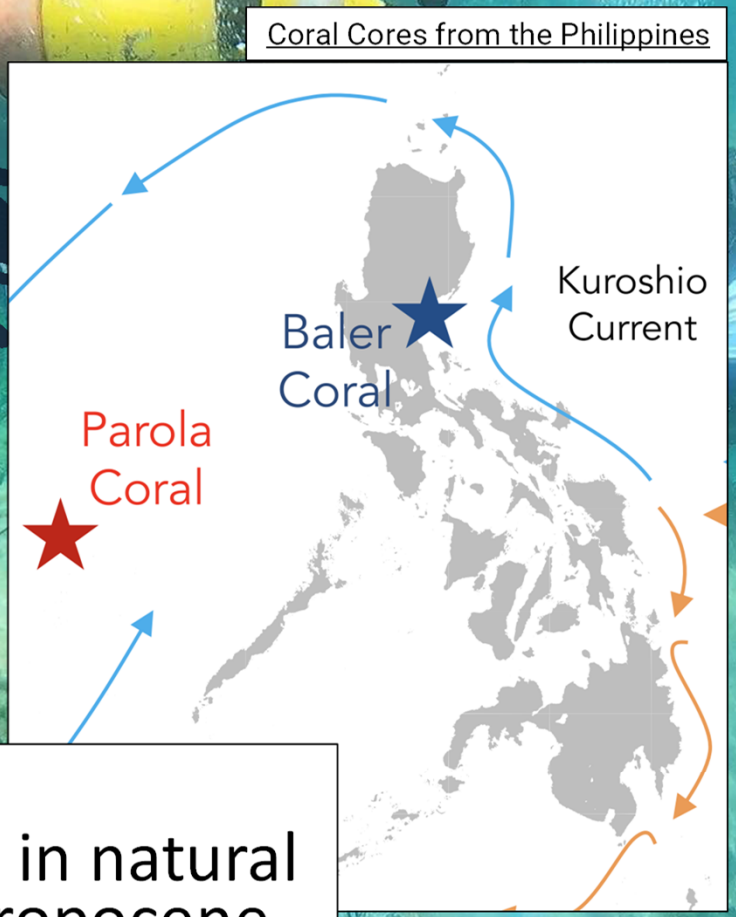
Climate Change Using Nuclear and Isotopic Techniques





OBJECTIVE:

explore ^{129}I ($T_{1/2}$ = 15.7 My) in natural archives as potential Anthropocene GSSP

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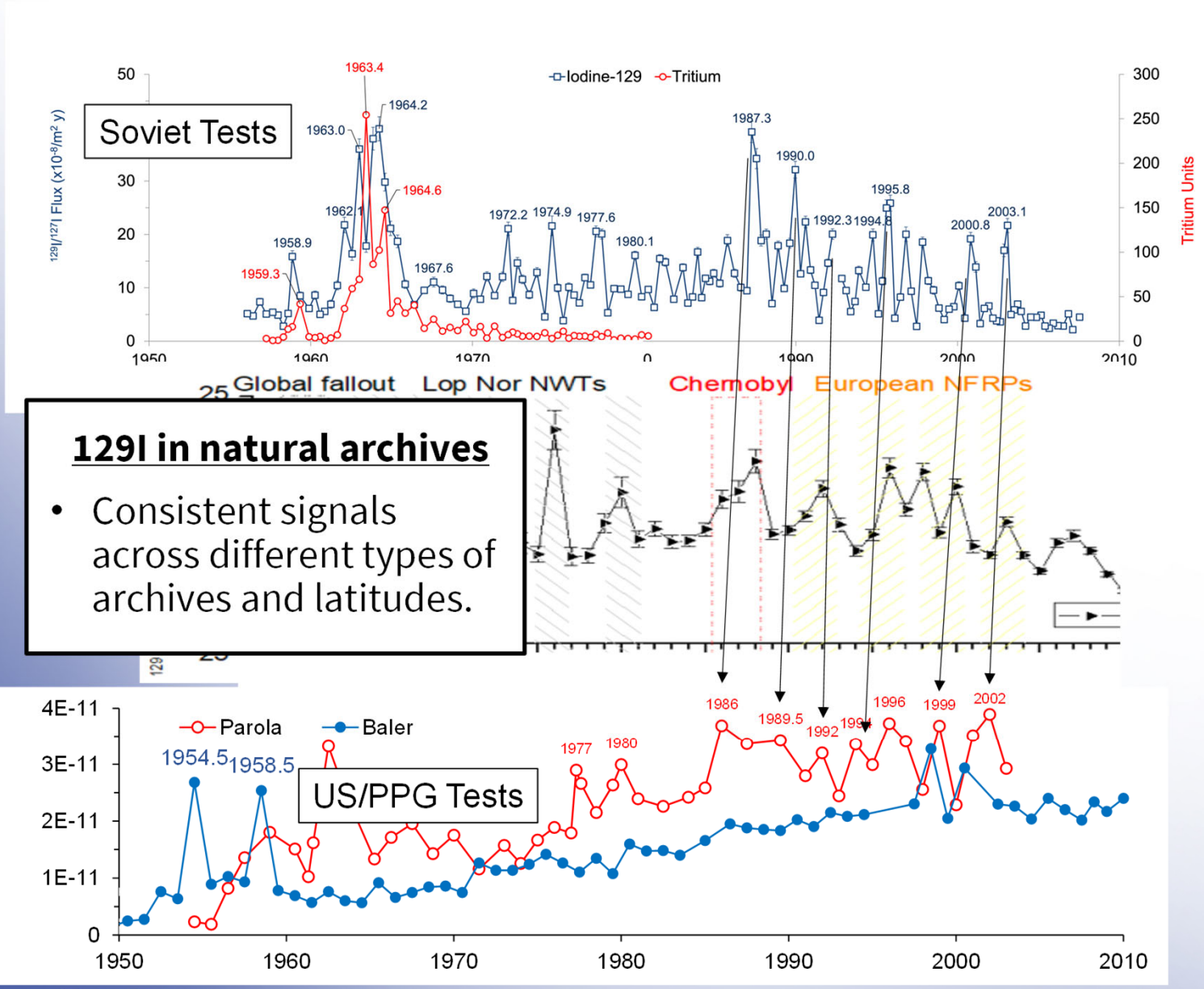
Climate Change Using Nuclear and Isotopic Techniques



129I in natural archives

- Consistent signals across different types of archives and latitudes.

Ice core, SE Dome (67°N)

Spruce tree rings, Qinghai-Tibet Plateau (36°N), *Zhao et al. 2019*

Coral cores, Philippines (11°-15°N)

Radioactive Waste Management

Solid / Liquid Wastes

Waste Type	Unconditioned		Conditioned		Radionuclide
	Vol./unit	Activity, Bq	Vol./unit	Activity, Bq	
Solid	~16 m^3	~1.5 x 10^9	~36 m^3	~1.3 x 10^8	Th-232, H-3, Cs-137, C-14, Co-60
Liquid, Aqueous	~1.6 m^3	~2.2 x 10^{10}	~2 m^3	~8.0 x 10^9	Co-60, H-3, Cs-137, C-14
Liquid, Organic	~3.6 m^3	~2.8 x 10^{10}	~0.03 m^3	~6.7 x 10^8	C-14, Cl-36, H-3, Sr-90

Disused sealed radioactive sources (DSRS)

Category	Number of units	Activity, Bq
Category 1	2	1.4E+14
Category 2	46	1.7E+14
Category 3	12	1.2E+12
Category 4	337	4.0E+12
Category 5	1898	3.7E+11
Uncategorized	169	No Data Available
Total	2464	~3.2E+14

Status	Number of Units	Activity, Bq
Transferred Units (Repatriated, For Rent etc.)	960	~6.5E+14
Units Released from Regulatory Control	2175	~3.5E+04
Total Units	3135	~2.1E+14

Continuous management of RW

- Implementation of the Radioactive Waste Management Registry (RWMR)
- Received (2022)
  - 441 units of DSRS
- Processed (Cat 3-5)
  - 322 units of DSRS (2021), 1967 units of DSRS (2022 to date)

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Radioactive Waste Management

Nuclear Materials

- Total Depleted Uranium (DU) ~2,300 kg
- Pu-238 from Air Ionizer - 5.3 kg (504 units)

THORIUM in gas mantles

20 (100-200L) drums of thorium mantle currently in storage at PNRI

Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications

Conducted trainings for Establishment of Mixing Plants and Quality Control in collaboration with the Department of Agriculture to make Bio N available in other areas for farmers consumption

Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications

PROJECT REHEAL:

Radiation-engineered HEmostatic Agents as Life-saving Devices-

CLINICAL INVESTIGATIONS OF SAFETY AND EFFICACY IN THE MANAGEMENT OF TRAUMATIC BLEEDING IN EMERGENCY SETTINGS

Main Objective: *To determine the safety and efficacy of the CMC granules and KPP dressing hemostatic devices in the management of trauma wound bleeding in emergency settings.*

Hemostat Prototypes (E-beam Crosslinked and Sterilized)

CARBOXYMETHYL CELLULOSE GRANULES

KAPPA-CARRAGEENAN/ POLYETHYLENE OXIDE DRESSING

PROJECT FRAMEWORK

Multi-center Clinical Trials

Safety and efficacy in the management of trauma wound bleeding in prehospital and hospital emergency settings.

GMP Production Trials

(1) GMP process development

(2) Optimization of rad processing parameters

(3) Validation and substantiation of 25 kGy as radiation sterilization dose

(4) Product Shelf-life

Cost-effectiveness Analysis

Hemostatic Devices (TRL 9)

(1) Technology Transfer

(2) FDA Registration

(3) Commercialization

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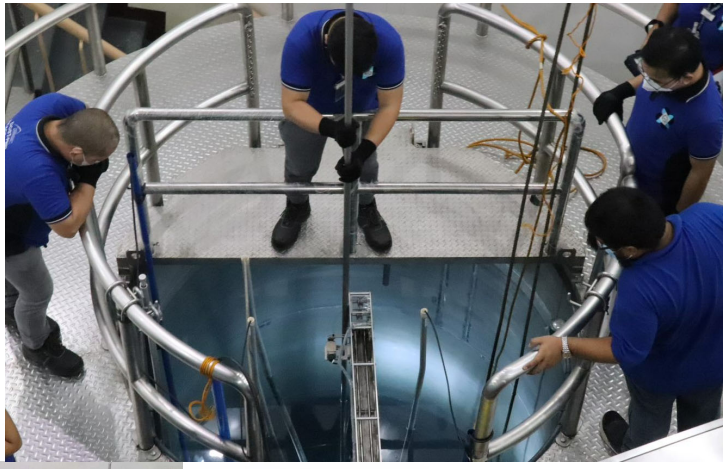
Research Reactor Utilization Project

PRR-1 SATER Commissioning



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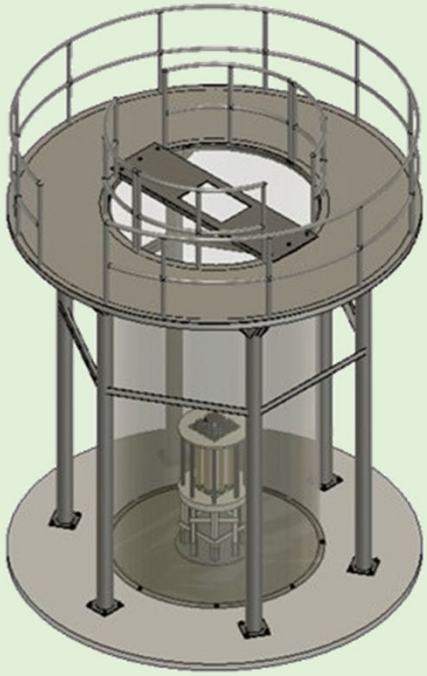
Research Reactor Utilization Project

IAEA **Internet Reactor Laboratory (IRL)** for distance learning: Agreement already signed, ongoing preparation of infrastructure

The IRL arrangement can supplement the limitation of SATER in the E&T aspect



PRR-1 SATER

PRR-1 SATER can provide local access to basic E, T, R & D in reactor physics and engineering

International Centres based on Research Reactors (ICERRs) and **FNCA**

*The ICERR and **FNCA** arrangement can supplement the limitation of SATER in the R&D aspect*

**Implementation of IRL will be funded through IAEA IRL project. Implementation of ICERR-related activities will be funded mostly through IAEA TC PHI0016, but with some support from local funding and TC PHI0017.

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Nuclear Safeguards and Security Project

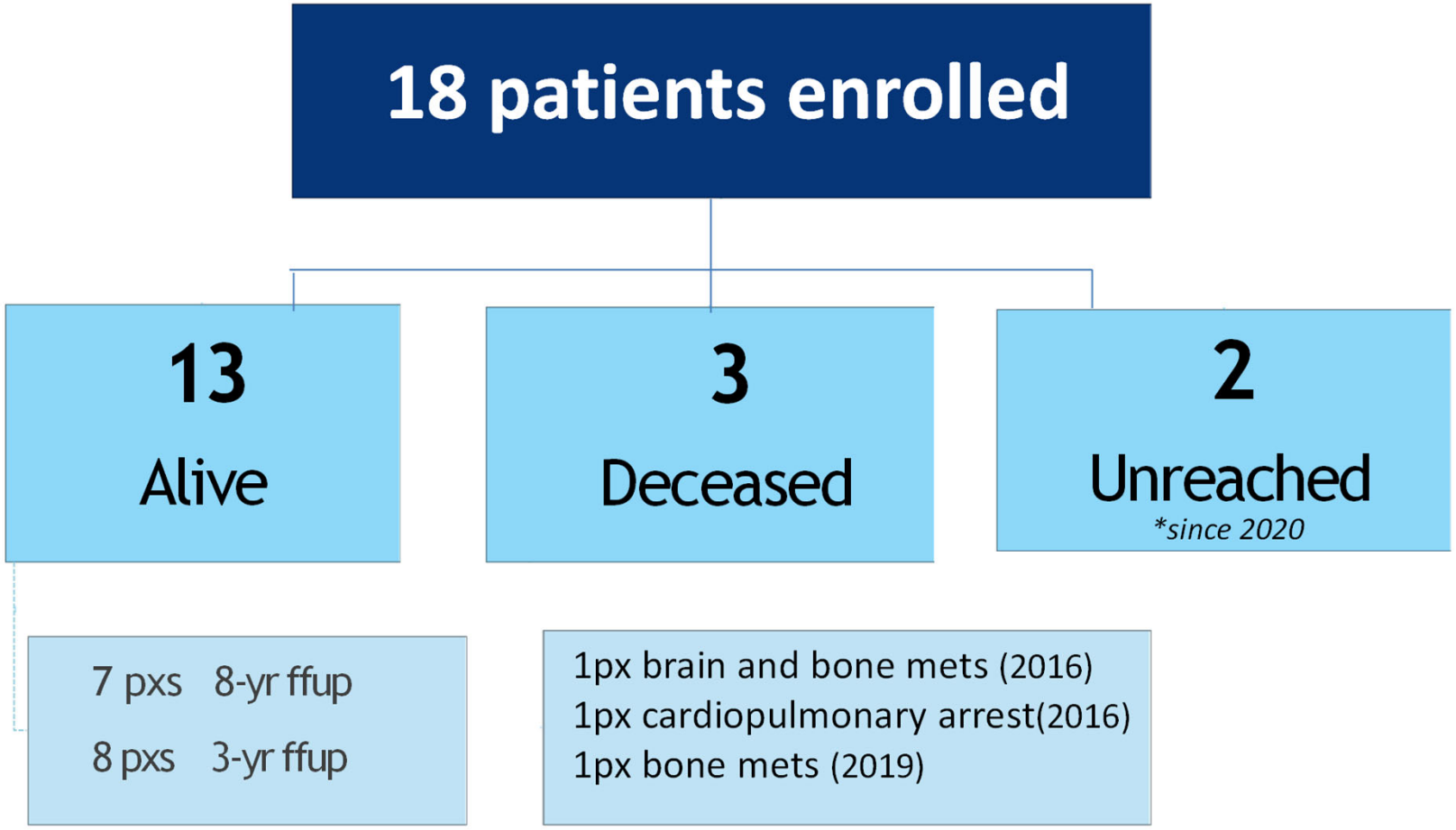
- NSDA Roadmap – with stakeholders for planning and implementation
- Review of the INSSP concluded last June 2022 which includes Nuclear Energy.
- Collaboration with US DOE INS on the Nuclear Security Engagement with different topics:
  - Security Considerations for SMRs Workshop
  - Nuclear Security Culture Overview
  - Regulatory Development Workshop
  - Standing –Up Regulatory Body Technical Exchange
  - Fundamentals of Threat Assessment and DBT
- USDOE ORS Site Assessment for Warranty Maintenance and Monitoring
- National Workshop on Developing a National Framework for Managing the Response to Criminal or Intentional Unauthorized Acts involving Nuclear or Other Radioactive Material

Radiation Oncology

- Participation on published and ongoing multicenter and regional clinical trials of FNCA (Cervix I-V, NPC I-III and Breast-I clinical trials) since 1993, through Dr. Miriam Joy Calaguas (PL) and Dr. Rey de los Reyes.
- Upcoming: Palliative Radiation Therapy Clinical Trials on Brain and Bone metastasis; Hybrid 2022 Workshop in Mongolia this September 28-October 2, 2022.
- Promotion of multidisciplinary team approach in the management of malignancies specifically on increasing awareness on the roles and indications of radiotherapy/radiation oncology.
- Increase in Image Guided Brachytherapy (IGBT) procedures specifically in cervical cancer in the Philippines.

Radiation Oncology

Breast-1 PMRT - August 2022



Radiation Oncology

Breast-1 PMRT - August 2022

13 patients alive

0	0	1
Intrabreast recurrence	Regional recurrence	Distant metastasis

1px bone mets
(completed Zoledronic Acid treatment 2021)

Radiation Oncology

Long-term followup – 13 patients (3-8yrs)

Late Adverse Effect	Grade RTOG 0	1	2	3	4
Skin	4	**9**	0	0	0
SubcutaCneous	**13**	0	0	0	0
Lungs	**13**	0	0	0	0
Heart	**13**	0	0	0	0

Radiation Oncology

Cervix-V IGBT - August 2022

8 patients enrolled

7
Alive

7pxs 3-4yrs ffup
no local recurrence
no distant metastasis

1
Deceased

1px Urosepsis secondary to Chronic Kidney Disease

Radiation Oncology

Long-term followup – 7 patients (3-4yrs)

Late Adverse Effect		Grade RTOG			
	0	1	2	3	4
Rectum/Sigmoid	**7**	0	0	0	0
Bladder	**4**	3	0	0	0
Small bowel	**6**	1	0	0	0
Skin	**7**	0	0	0	0

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