

PHYTOSANITARY IRRADIATION: EXISTING MARKET AND NEW DEVELOPMENTS IN INDIA



Presented by
Arjun Vas
Director
Symec Engineers (India) Pvt. Ltd.





INTRODUCTION

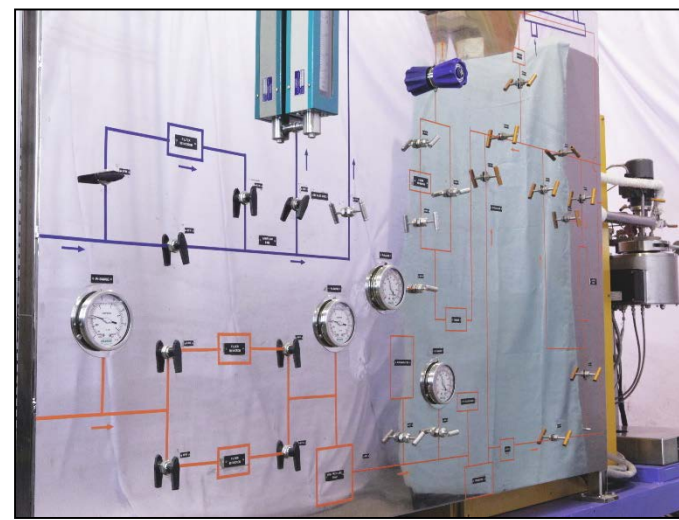
Symec Engineers (I) Pvt. Ltd. is an Engineering company engaged in developing high technology custom designed equipment and systems for Nuclear, Biotech, Pharmaceutical, chemical and food processing industries.



Gamma Irradiation plants



Automated material handling systems & SPM's



Process equipment



MILESTONES IN GAMMA IRRADIATION

FIRST PRIVATELY BUILT GAMMA IRRADIATION FACILITY

- INDIA'S FIRST PRIVATE GAMMA IRRADIATION FACILITY WAS BUILT BY SYMEC (KIDWAI MEMORIAL, BANGALORE)

FIRST AGRO IRRADIATION FACILITY

- INDIA'S FIRST AGRO IRRADIATION FACILITY WAS COMMISSIONED BY SYMEC (KRUSHAK, LASALGAON, MAHARASHTRA)

FIRST BATCH TYPE IRRADIATION FACILITY

- INDIA'S FIRST BATCH TYPE IRRADIATION FACILITY WAS BUILT BY SYMEC (MICROTROL STERILIZATION SERVICES, BANGALORE)

LARGEST IRRADIATION PLANT IN THE COUNTRY

- THE LARGEST IRRADIATION PLANT IN INDIA WAS BUILT BY SYMEC (5 MCI FACILITY FOR NIPRO INDIA CORPORATION, SHIRWAL, MAHARASHTRA)

USDA-APHIS APPROVED

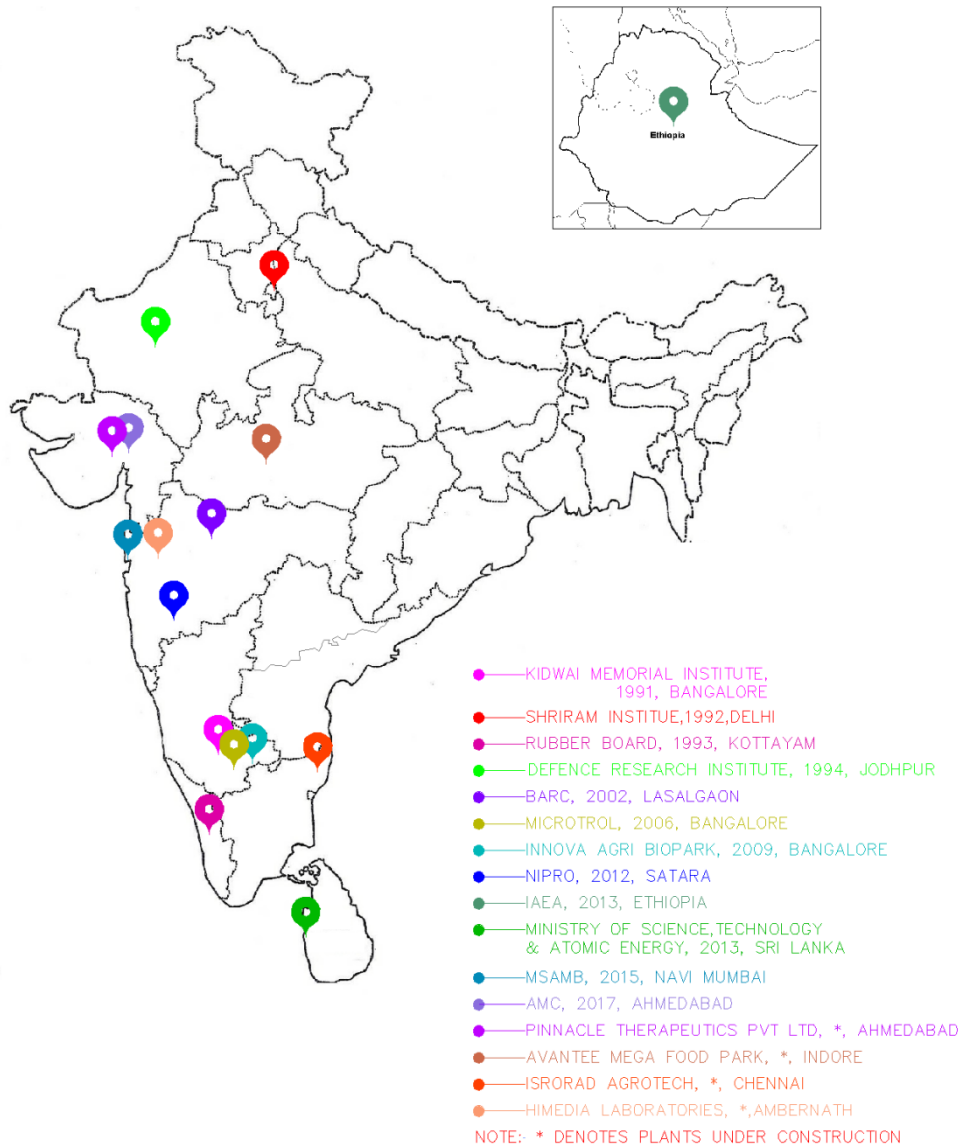
- ALL THREE AGRO IRRADIATION FACILITIES IN INDIA CURRENTLY APPROVED BY USDA-APHIS FOR EXPORT TO USA WERE COMMISSIONED BY SYMEC

BULK PRODUCT IRRADIATION FACILITY

- IN 2017, SYMEC COMMISSIONED INDIA'S FIRST BULK IRRADIATION PLANT FOR TREATING DRY SEWAGE SLUDGE



GAMMA IRRADIATION PLANTS BUILT BY SYMEC



EXISTING MARKET



BACKGROUND

- **Technology first introduced in India in the late 1960's.**
- **Cobalt-60 source is produced and supplied indigenously by the Board of Radiation and Isotope technology, Govt of India.**
- **Currently about 20 gamma irradiation plants have been built and commissioned in the country. 5 more facilities are under construction.**
- **3-4 low energy E-beam facilities exist in the country, primarily dedicated to cable cross linking.**
- **Majority of the Gamma Irradiation plants are involved in High/Medium dose irradiation of medical disposables, spices, herbal products and pet food.**



AGRO IRRADIATION

- **India is among the largest producers of fresh fruits , vegetables, meat, seafood and food grains in the world.**
- **Post harvest losses are high due to the temperate climate, improper storage, treatment and packing infrastructure, poor transportation networks etc.**
- **Significant percentage of these losses can be reduced if the food products are irradiated and stored properly.**
- **However, only a very small fraction of food products are currently irradiated, and are primarily for export/ quarantine related applications.**



UNIQUE FEATURES OF THE INDUSTRY

- **Most plants are metro-centric and located in Tier 1 cities such as Mumbai, Bangalore and Delhi and consequently, have higher real estate costs.**
- **High incidence of merchant plants involved in contract irradiation rather than in-house irradiation.**
- **Lower production volumes and dispersed production centers.**
- **Mature market for High/Medium dose irradiation.**
- **Highly cost sensitive market with a lack of financing options for irradiation projects.**



NEW DEVELOPMENTS



Significant improvement
in Infrastructure



Make in India initiative



Focus on Integrated Food
Processing facilities

PHYTOSANITARY IRRADIATION IN INDIA



BACKGROUND

- **Phytosanitary irradiation began in India in 2007, when USDA (United States department of Agriculture) framed rules to allow import of irradiated mangoes at 400Gy from India to USA.**
- **Initially, a single facility, which was located very far from both the growing and export nodes was licensed.**
- **Recently, however, two more facilities have been licensed, and several more are under construction.**
- **The technology is however beset by several obstacles, which limit the quantity and quality of the products exported.**
- **Currently, only two products are approved for export post-irradiation treatment**



Products - Mango

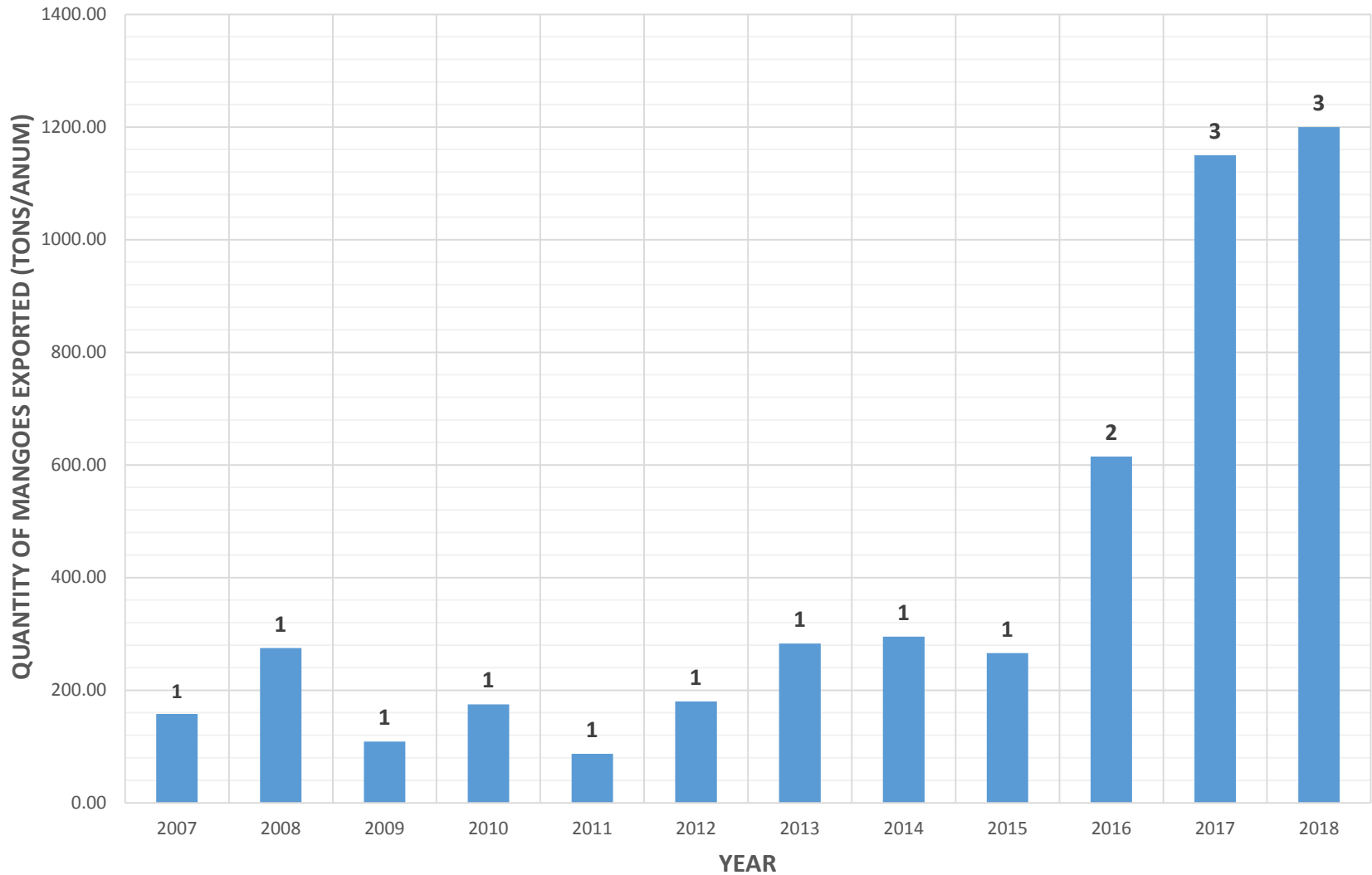
- India worlds largest producer at 14 million MT/annum
- Majority of produce for the domestic market, however exports growing annually
- USA, the worlds largest mango importer (250000 MT/year) had denied market access to Indian mango producers & exporters till 2007

Export data for Indian Mangoes (2016-17) (Source: APEDA)

Country	Quantity (in MT)	Value (in USD)
United Arab Emirates	28,483.16	37,476,130
United Kingdom	3,030.79	7,428,794
Saudi Arabia	2,371.99	3,689,465
Qatar	2,254.19	3,230,253
Kuwait	1,100.19	2,895,323
Nepal	9,415.38	2,392,070
United States	615.53	2,321,095
Bahrain	1,086.00	1,480,930
Singapore	840.69	1,320,487
Oman	897.88	1,236,312



Products – Mango - Quantities





Products - Pomegranate



- **India is one of the world's largest producers and exporters of Pomegranates**
- **USDA approved imports of Pomegranates with a minimum dose of 0.4kGy in 2012**
- **First shipment of Indian Pomegranates (324 boxes) sent to the US in 2016 after irradiation at IFC, Navi Mumbai**
- **Given abundance of the fruit and multiple harvesting seasons, huge potential exists for growth of exports**



OBSTACLES

INFRASTRUCTURE

- Lack of supporting infrastructure such as cold stores, pack houses.
- Currently only three licensed irradiation facilities in the country.

LOGISTICS

- Lack of end-to-end cold chain maintenance.
- Shortage of suitable transport options from India to USA both via Land and Sea.
- Long transportation times from growing to processing to export nodes.
- Poor Packaging and handling practices.
- Palletized handling is not currently practiced.
- Lack of linkages between Indian exporters and large retail chains in the US.

REGULATIONS

- Licensing and approval process is lengthy, time-consuming and stringent.
- Requirement that irradiation only be carried out in the presence of the inspector reduces working hours and profitability.
- Inability to process other products in the growing season deters many plant owners.
- Only two products currently approved.

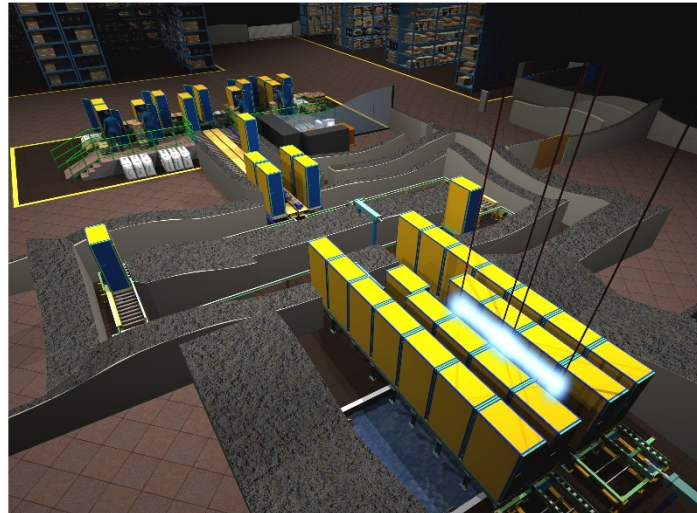
**CURRENT PLANTS INVOLVED
IN PHYTOSANITARY
IRRADIATION IN INDIA**



IFC, NAVI MUMBAI



Design Capacity: 500 KCi
Products: Agro Products & Spices





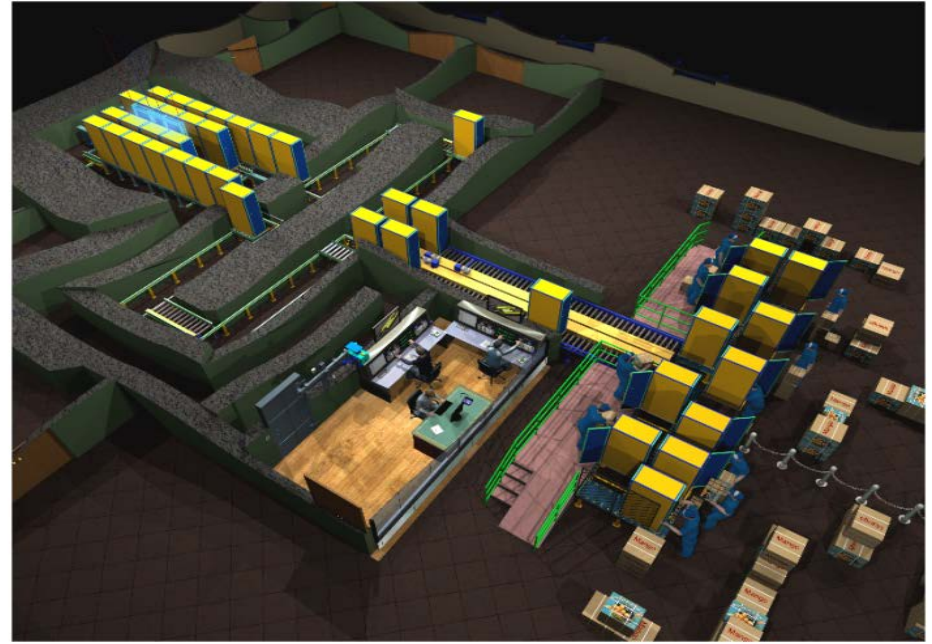
KRUSHAK FACILITY, LASALGAON, MAHARASHTRA



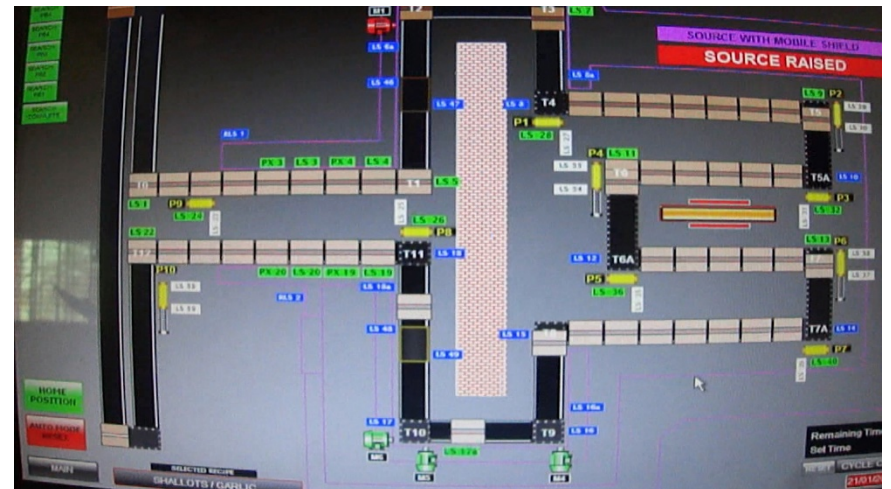
Design Capacity: 500 KCi
Products: Agro Products & Spices



INNOVA, BANGALORE.



Design Capacity: 500 KCi
Products: Agro Products & Spices



**NEW DEVELOPMENTS-
ECONOMICAL SMALL SCALE
IRRADIATION FACILITY**



EXECUTIVE SUMMARY

- **India has a vast potential for irradiation treatment of agro products.**
- **However, despite years of existence in the country, the technology has not reached its full potential with only a few irradiation plants in the country treating agro products**
- **The major obstacle in many projects, is the cost involved in setting up an industrial gamma irradiation facility.**
- **Goals of the concept:**
 - Cost of less than half the existing designs
 - Designed for only agro products with a dose range of 0.1 to 10 kGy
 - Designed for a maximum source loading of 500 Kci
 - Batch type operation with palletized products
 - Simplified handling system with manual loading and unloading of the products



PROJECT GOALS

LOW COST

- Greater than 50% reduction in civil works footprint and concrete quantity.
- Reduction in level of automation and conveyors.
- Reduction/ Elimination of tote boxes for storing products.
- Simplified control system with required safety features.

EASE OF OPERATION AND MAINTAINENCE

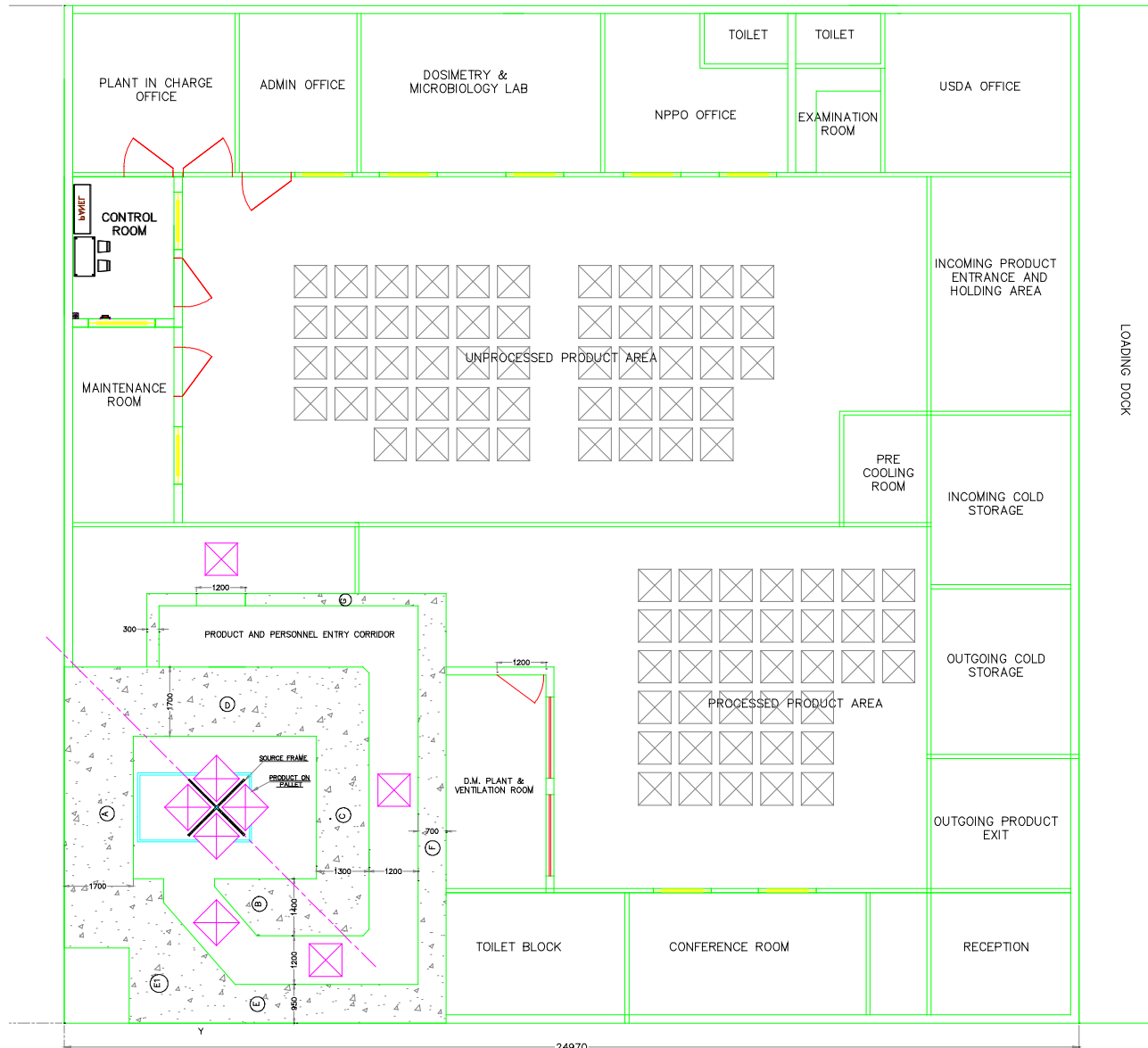
- Preference for palletized products which require minimal handling.
- Manual loading and unloading of the pallets into the plant, with hand operated pallet trucks.
- Minimal no of drives and motors to reduce maintenance.
- Safety system compliant to AERB SS-6/IAEA SSG-8 standards.
- Minimal requirement for Dummy Material

VERSATILITY

- Ability to treat all agro products in same plant.
- Batch mode operation for quick changeover between products.
- Provision for cell chilling system to treat temperature sensitive products.
- Different product sizes should be accommodated to allow flexibility in operation.
- Source frame designed for multiple design of pencils including W91, BC188 and future Cesium pencils.

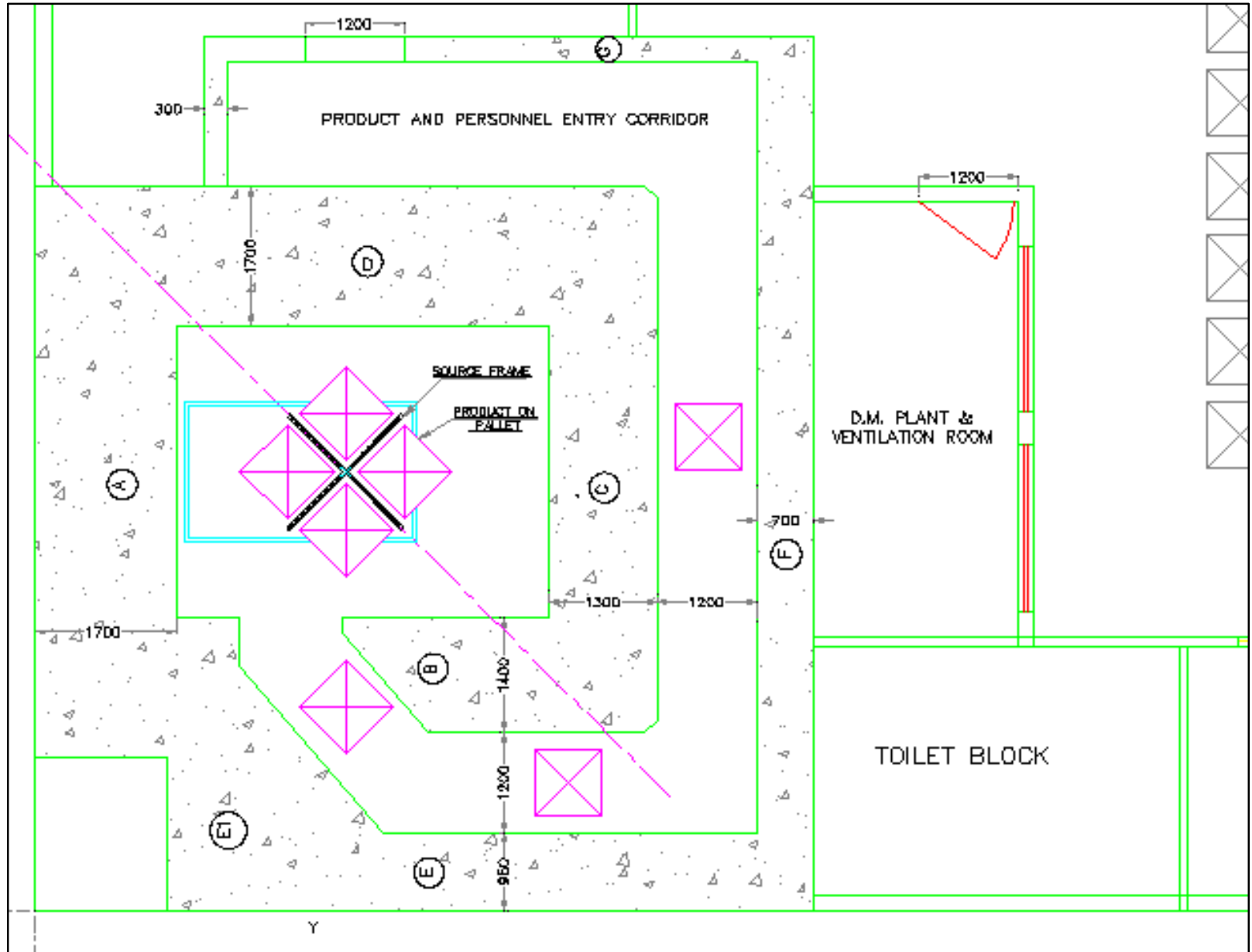


BUILDING LAYOUT



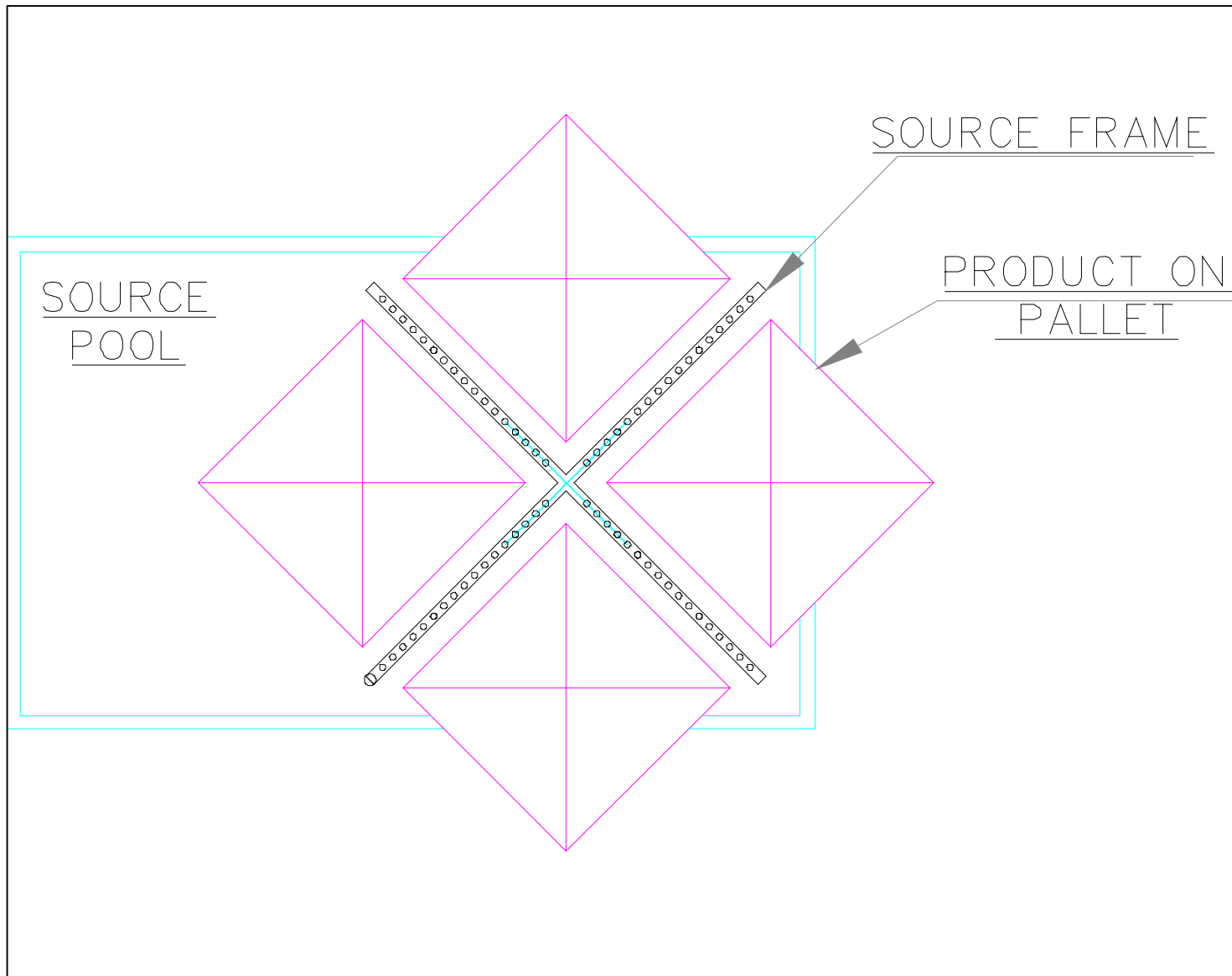


PLANT LAYOUT



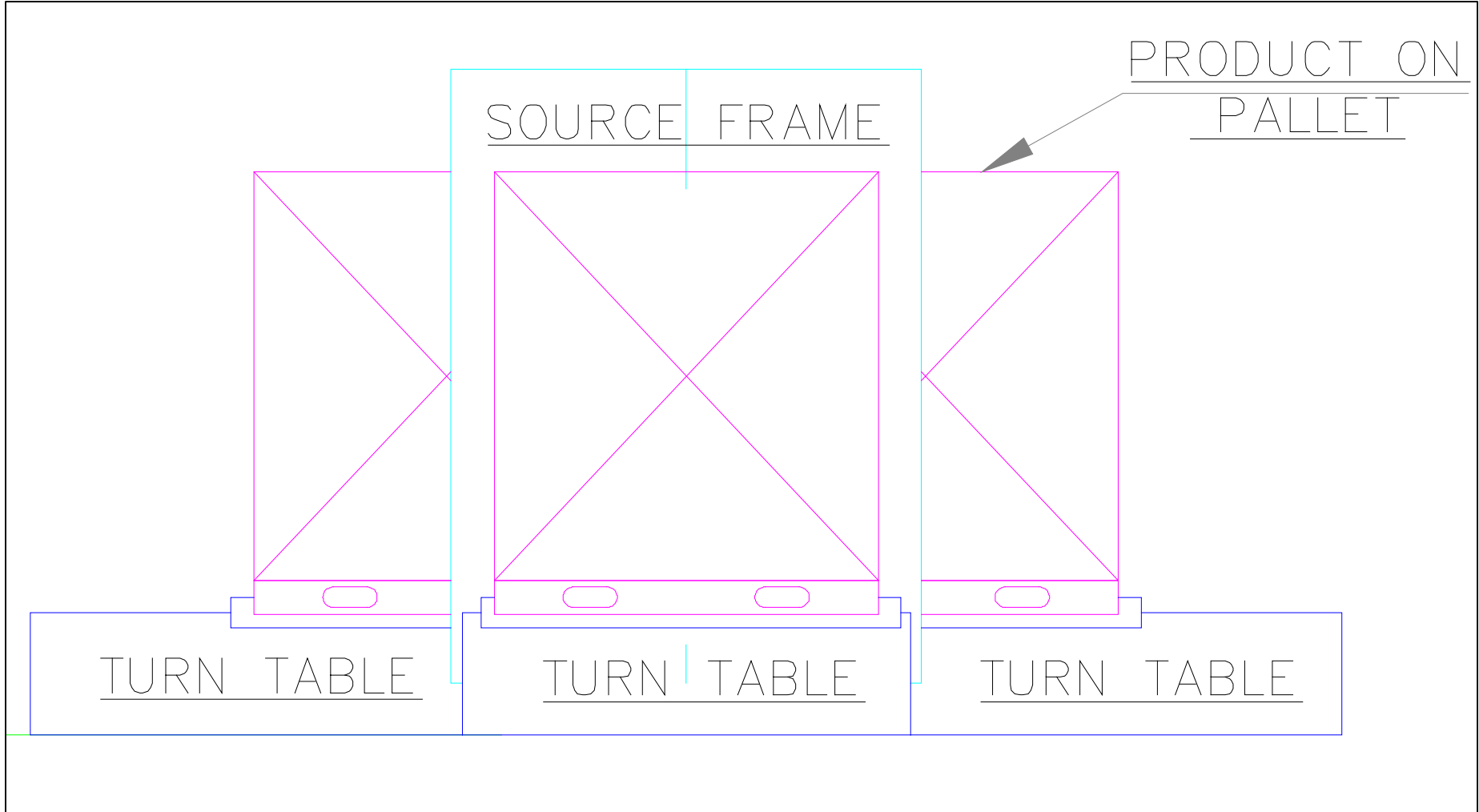


PRODUCT ARRANGEMENT PLAN





ELEVATION





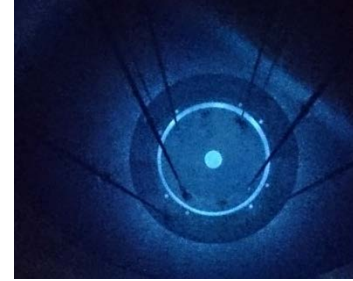
SEQUENCE OF OPERATION



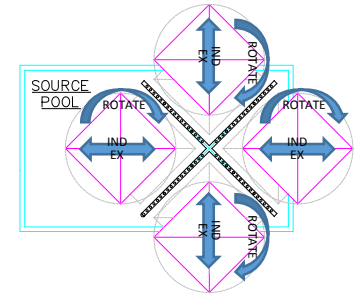
Palletized, wrapped products arrive at the facility and are inspected before loading



Pallets are transported manually into the irradiation cell via pallet truck and are loaded onto the turntables

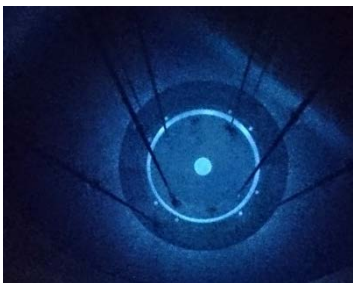


After the safety procedures, source is raised for irradiation



After one half cycle Pallets are rotated by 180° by turntables

After one cycle is finished, source is lowered into the pool automatically



Current batch of four pallets is unloaded, and next batch is loaded



Treated pallets go through QC, dose validation and documentation prior to dispatch



QC cleared goods are dispatched with the requisite documentation.





PLANT SPECIFICATIONS

SR. NO.	FEATURE	DESCRIPTION
1	Category of irradiator.	Panoramic wet source storage. Category IV (ref AERB-SS-6, rev-1 / IAEA SSG-8).
2	Product to be irradiated.	Agro products including fresh fruits and vegetables, food grains, potatoes & onions, spices, herbal products, dehydrated vegetables, Chilled meat & seafood, Pet food, Honey, Cut flowers etc
3	Maximum design source strength.	500 kCi (Cobalt-60 / Vitrified Cesium source)
4	Mode of operation.	Batch type plant with Source overlap design & in cell Turntables for four sided exposure.
5	Source Frame	X-type Rectangular stainless steel source plaque with Three tier source racks designed for W91 /BC 188 / Cesium Pencils.



PLANT SPECIFICATIONS

SR. NO.	FEATURE	DESCRIPTION
6	Source movement system.	Hydraulic cylinder, interlocked with personnel/product entry door through SS wire ropes .
7	Maximum design throughput of conveyor.	2.5 Mtons/ hr @ 500 kCi (Avg. dose: 0.625 kGy & Density of 0.6 g/cc)
8	Product Pallet dimension	Standard square pallets of size 1mx1m to 0.6mx 0.6m with product height between 1200-1400mm.
9	Civil works dimensions	<ul style="list-style-type: none">• Irradiation Cell: 10.5 (L) x 9.4 (W)x 4(H) meters (external dimensions)• Plant Building : 25x25x11m shed with PPGI walls and roof.• Overall Plot size: 1500 Sq meters



PRODUCTS TO BE IRRADIATED

Hygienization



Pet food

Disease prevention: AFB, Thai Sac, etc.



Honey & Beekeeping Equipment

Sprout Inhibition



Potatoes, Onions, Garlic etc.

Hygienization



Dehydrated vegetables

Hygienization



Spices, herbal products
and nutraceuticals

Shelf Life Extension and
decontamination



Meat, Poultry and RTE products

Insect Disinfestation



Cereals, Pulses &
Dry Fruits

Quarantine



Cut flowers & Fresh Fruits for
Export



PLANT OUTPUTS

Product	Dose Range	Bulk Density (gm/cc)	*Production /Hr. @ 500 KCi
Fresh Fruits & Vegetables	0.25 to 1 kGy	0.35	1.5 MT/Hr.
Rice, Wheat, Cereals and Pulses	0.25 to 1 KGy	0.6	2.5 MT/Hr
Potatoes, Onions, Garlic	0.02 to 0.2 KGy	0.4	2.5 MT/Hr
Spices, Herbal Product & Pet Food	6 to 14 KGy	0.35	0.8 MT/Hr

Note: The above values are estimates and actual values may vary by +/- 10%.



COMPARISON TO TYPICAL PLANT

PARAMETER	TYPICAL PLANT	PROPOSED PLANT
MAX SOURCE LOADING	1000 Kci	500 Kci
SOURCE GEOMETRY	Product Overlap	Source Overlap
SOURCE FRAME	Rectangular	X-frame
PRODUCT HANDLING	Products Loaded Into Aluminum/Steel Tote Boxes	Products Handled In Pallets / Palletized containers
CONVEYOR SYSTEM	Roller Conveyors In Cell And Labyrinth	Only Turntables In Cell
MAX OUTPUT (0.6 gms/cc product)	10 Tons/hr	2.5 Tons/hr



COMPARISON TO TYPICAL PLANT

PARAMETER	TYPICAL PLANT	PROPOSED PLANT
CELL SIZE	28 M (L) X 15 M (W) X 6.5 M (H) meters (external dimensions)	10.5 (L) x 9.4 (W)x 4(H) meters (external dimensions)
BUILDING SIZE	1500 Square Meters	625 Square Meters
PLOT SIZE	4400 Square Meters	1500 Square Meters
SAFETY STANDARD	AERB SS-6 , Rev 1/IAEA SSG -8	AERB SS-6, Rev 1/IAEA SSG-8
CONCRETE REQUIREMENT	1130 Cubic Meters	450 Cubic Meters
SOURCE RAISE SYSTEM	Hydraulic	Hydraulic



CONCLUSION

Low Cost – Almost half the cost of existing Irradiators with minimal operational costs

Ease of Operation – Batch mode with Palletization resulting in minimal Product handling and very low maintenance requirements

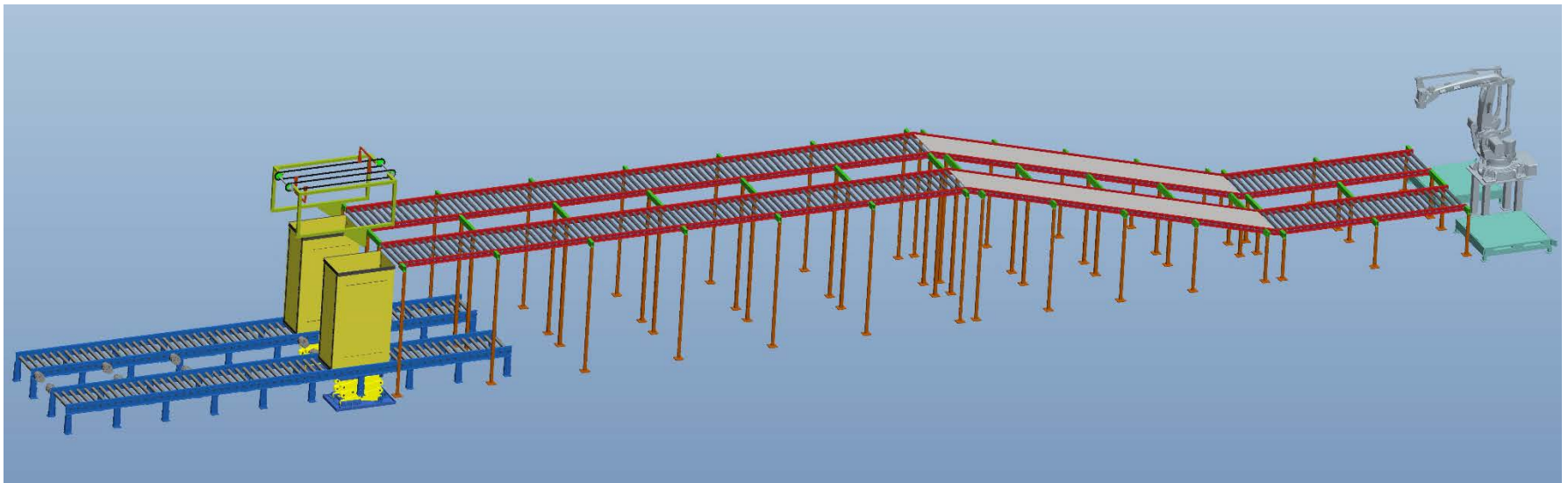
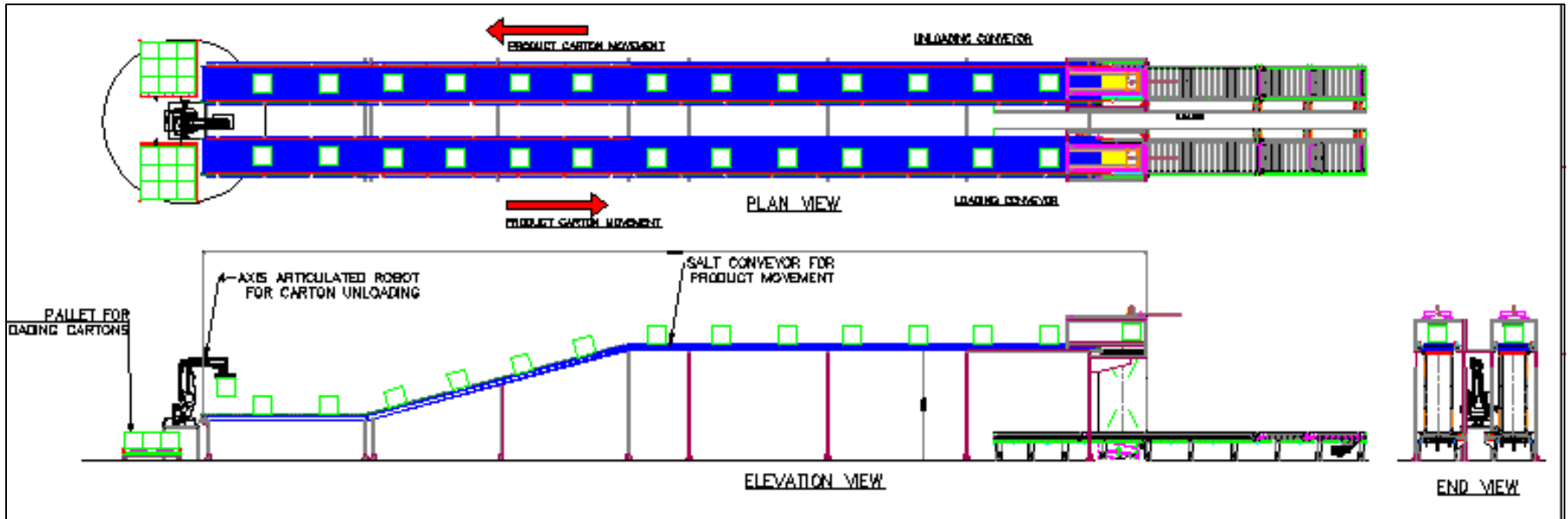
Tailor Made Design – Adequate to meet quantities of agro products currently available in the market

Future Potential - Such a facility can greatly improve viability and economic feasibility of Agro Irradiation in India

NEW DEVELOPMENTS - PLANT FEATURES



AUTOMATED LOADING / UNLOADING / PALLETIZING





BULK MATERIAL HANDLING





CELL CHILLING SYSTEM





SPLIT SOURCE FRAME



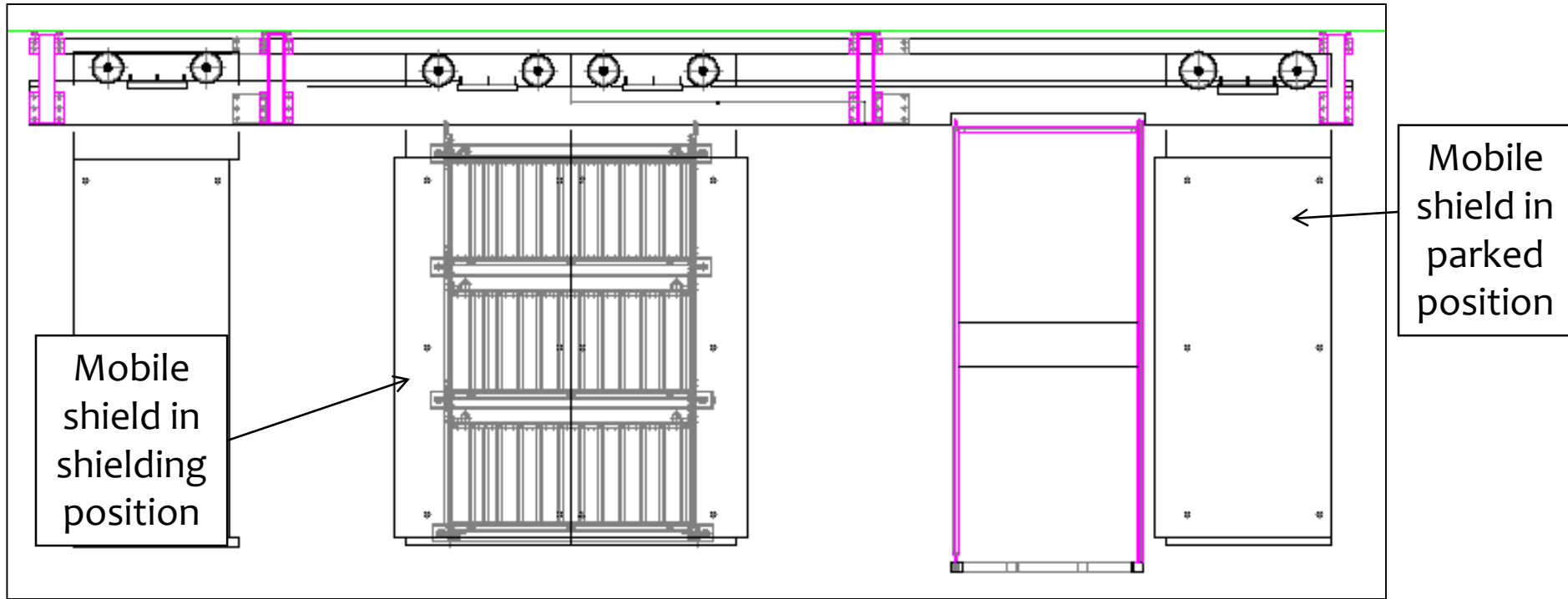
Big Source frame with Dummy Pencil

Source Dummy Pencil

Smaller Source frame with Dummy Pencil



MOVING SHIELDING



**TYPICAL DRAWING OF A MOBILE SHIELD FOR ULTRA LOW DOSE IRRADIATION.
DOSE RANGE-0.01 KGRAY TO 0.1 KGRAY**

**SOME OF OUR OTHER RECENT
WORKS - FOOD PROCESSING**



LITCHI PROCESSING SYSTEM



THANK YOU FOR YOUR TIME

CONTACT DETAILS

Symec Engineers (India) Pvt. Ltd.

A-86, MIDC Khairane, TTC Indl. Area, Thane Belapur Road,

Navi Mumbai – 400705, India

Email - arjunvas@symecengineers.com

Office Tel No. - +919029080556/424

Mobile No. - +919987621889