

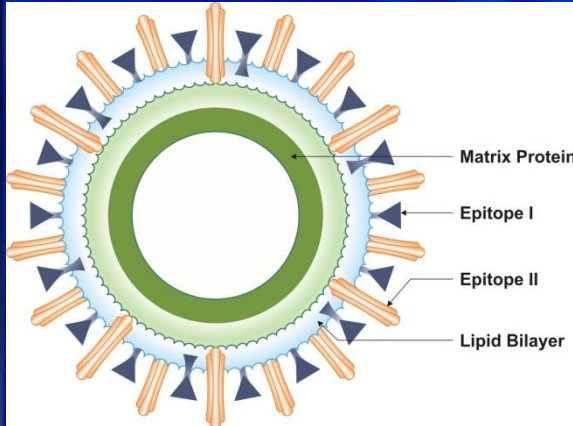


VLP based technology for Vaccines

**RAJ MEHTA
PRESIDENT**

**CADILA BIOTECH
PHARMACEUTICALS LTD
AHMEDABAD, INDIA**

What are VLPs?



Schematic representation of VLP

influenza VLP:

Epitope I = Hemagglutinin (HA)

Epitope II = Neuraminidase (NA)

- Is a recombinant-expressed viral proteins that spontaneously assemble into 3-D structures similar to parent virus
 - By electron microscopy, VLPs mimic the parent virus
 - Immune response is similar to that which would be seen if exposed to the parent virus
- ✓ Not contain any genetic material
- ✓ Can not replicate

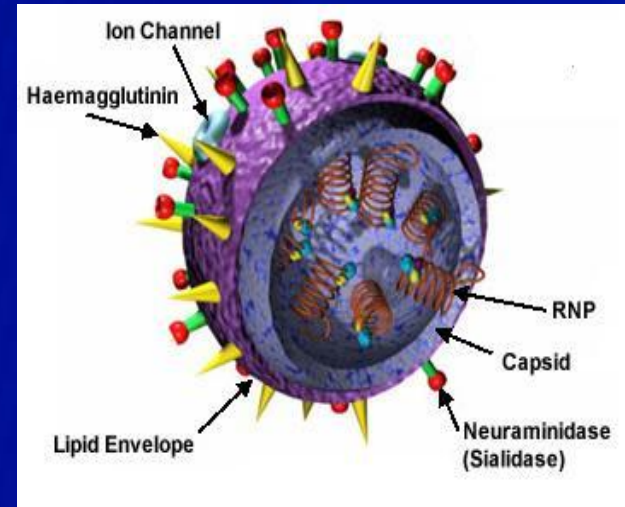
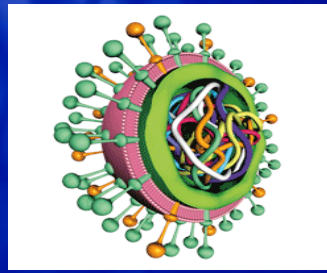
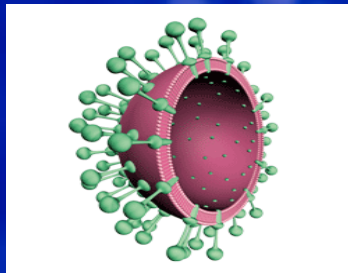
Partnership in VLP technology platform

- Partnership with Novavax for developing VLP based technology for vaccines
- Novavax successfully cloned several genes for different vaccine in baculo-virus and expressed the protein in Insect cell line
- Proof of concept has been established in animal model and some vaccine tested in human
- Manufacturing process, analytical characterization and stability of product has been demonstrated



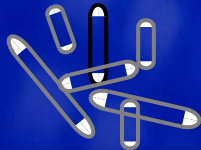
Development of Recombinant Influenza VLP Vaccines

- Select proteins important for inducing protective immunity
 - Surface hemagglutinin (HA)
 - Neuraminidase (NA)
 - Matrix (M1)



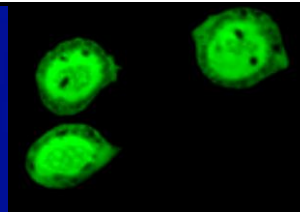
Genes coding for the HA, NA, and M proteins are put into baculovirus

rBaculovirus



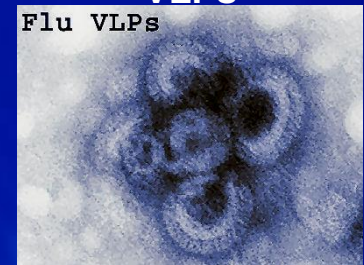
Infect cell culture (Sf9) with baculovirus

Baculovirus-infected Sf9 Cells



Recombinant proteins (HA, NA, M1) form VLPs

Flu VLPs

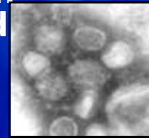


VLP Technology: Salient Features

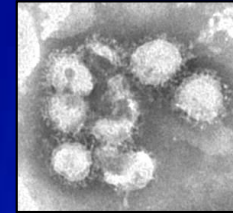
- No Live pathogenic virus, Baculo Virus expression system
- Exact genetic match to circulating virus (HA, NA, M1)
- Faster Delivery- cloning & development to release (10 to 12 weeks)
- Easy to scale-up and manufacture in large quantity
- Disposable manufacturing Solutions.



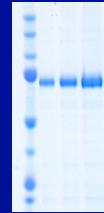
H1N1 Virus RNA
H1N1 Strain from CDC
Announced



H1N1 VLPs



HA Reagent

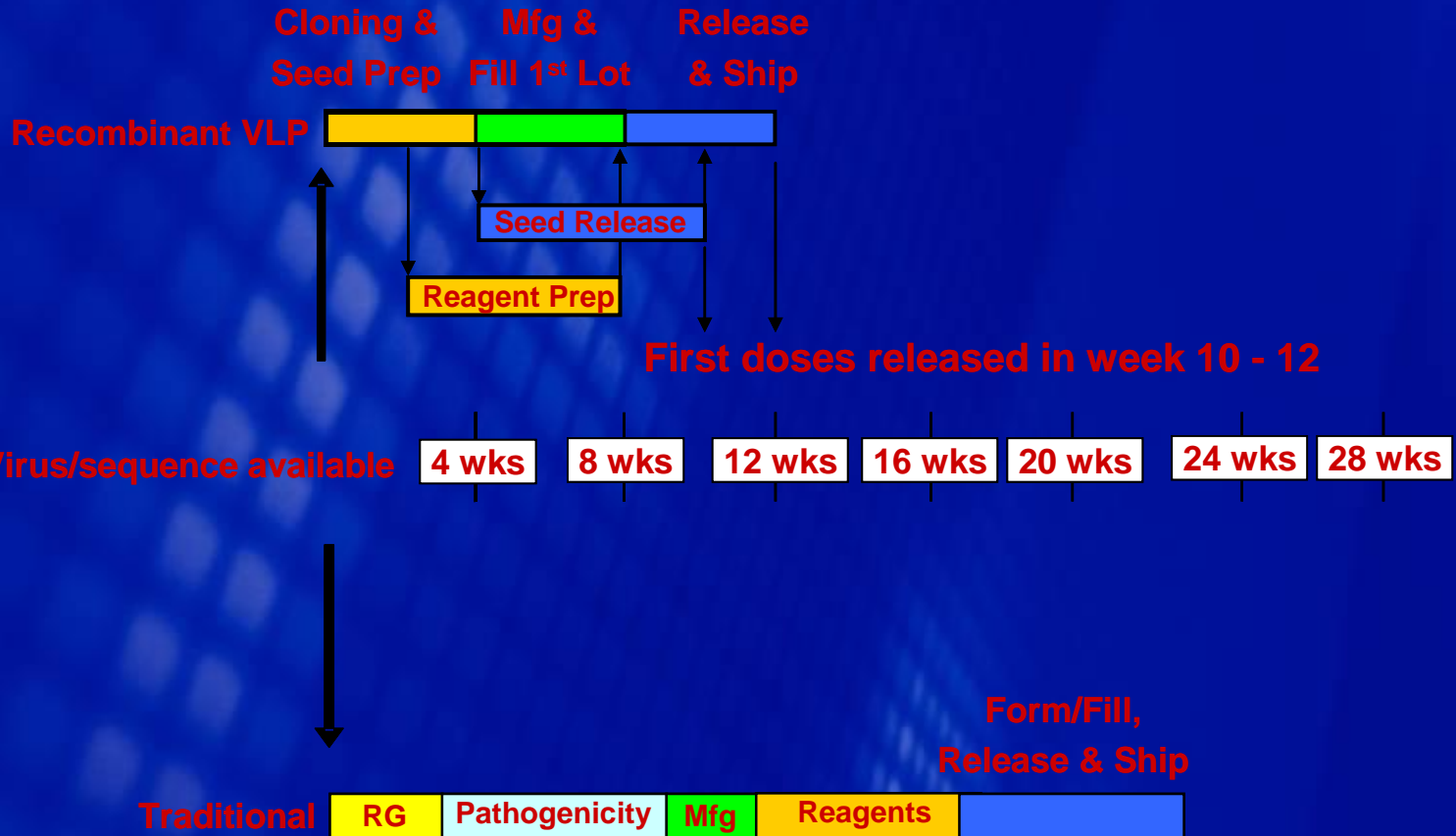


← HA

Task Name	Start	Finish	Apr 2009							May 2009																			
			24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 H1N1 Vaccine Starts	4/24/2009	4/24/2009	█																										
2 Viral genes A/CA/04/09 received from the CDC	4/24/2009	4/28/2009	█	█	█	█	█																						
3 A/CA/04/09 genes cloned	4/29/2009	5/4/2009						█	█	█	█	█																	
4 Recombinant baculovirus generated	5/5/2009	5/10/2009											█	█	█	█	█												
5 VLP Production for preclinical study	5/11/2009	5/14/2009																				█	█	█					
6 HA reagent production	5/15/2009	5/19/2009																									█	█	█

Influenza Vaccine (Traditional vs. VLP)

Faster Delivery of First Dose of Pandemic Vaccine



Influenza vaccine- Joint Venture March 2009

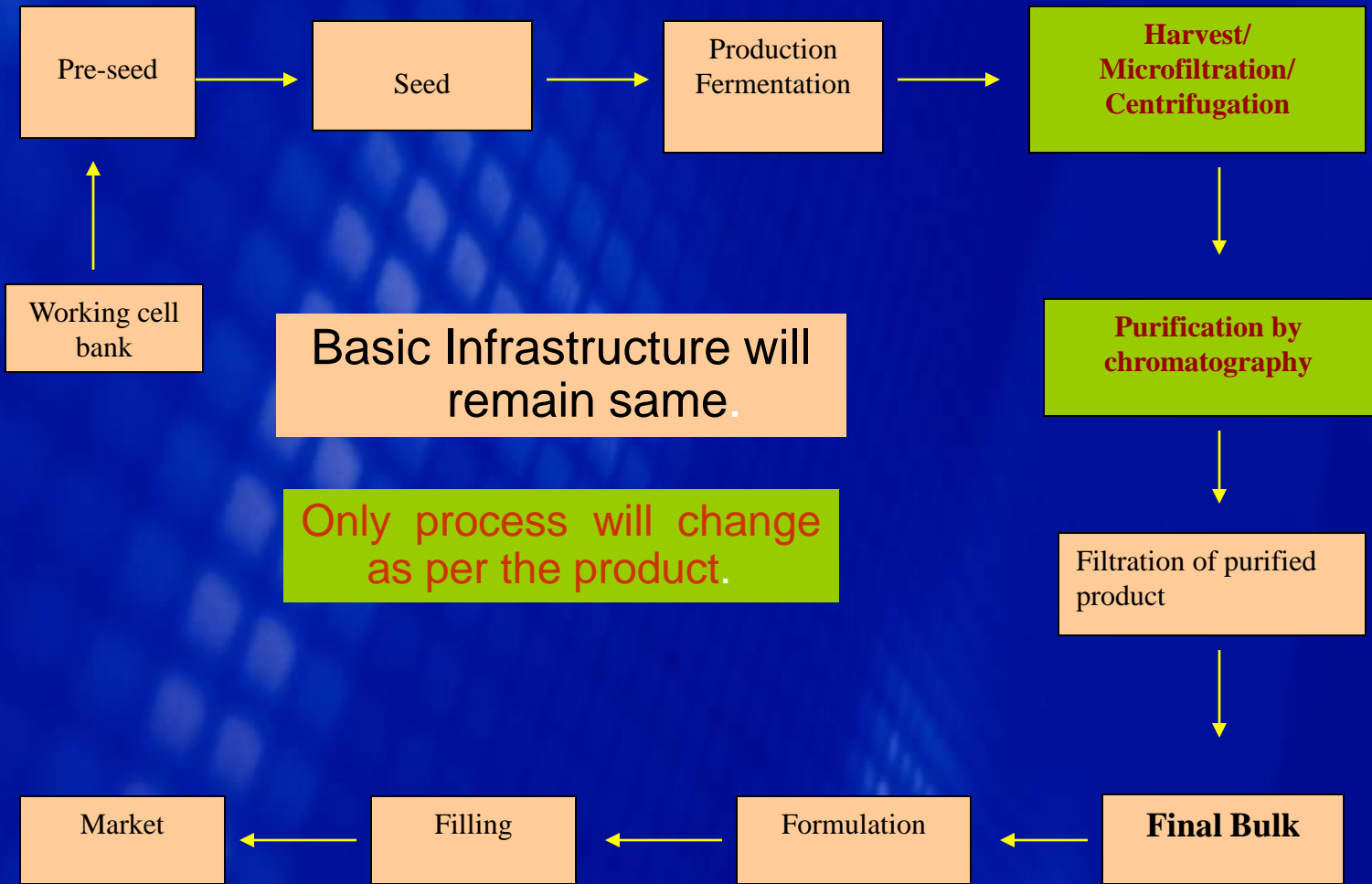
- Influenza VLP Process Technology Transfer Initiated (May, 2009)
- Facility Design Initiated (June, 2009)
- Facility Ground Broken (November, 2009)
- Facility Expected Completion (May, 2010)
- Process, Analytical Transfer Ongoing in Parallel
- Facility Commissioning and Validation (July, 2010)



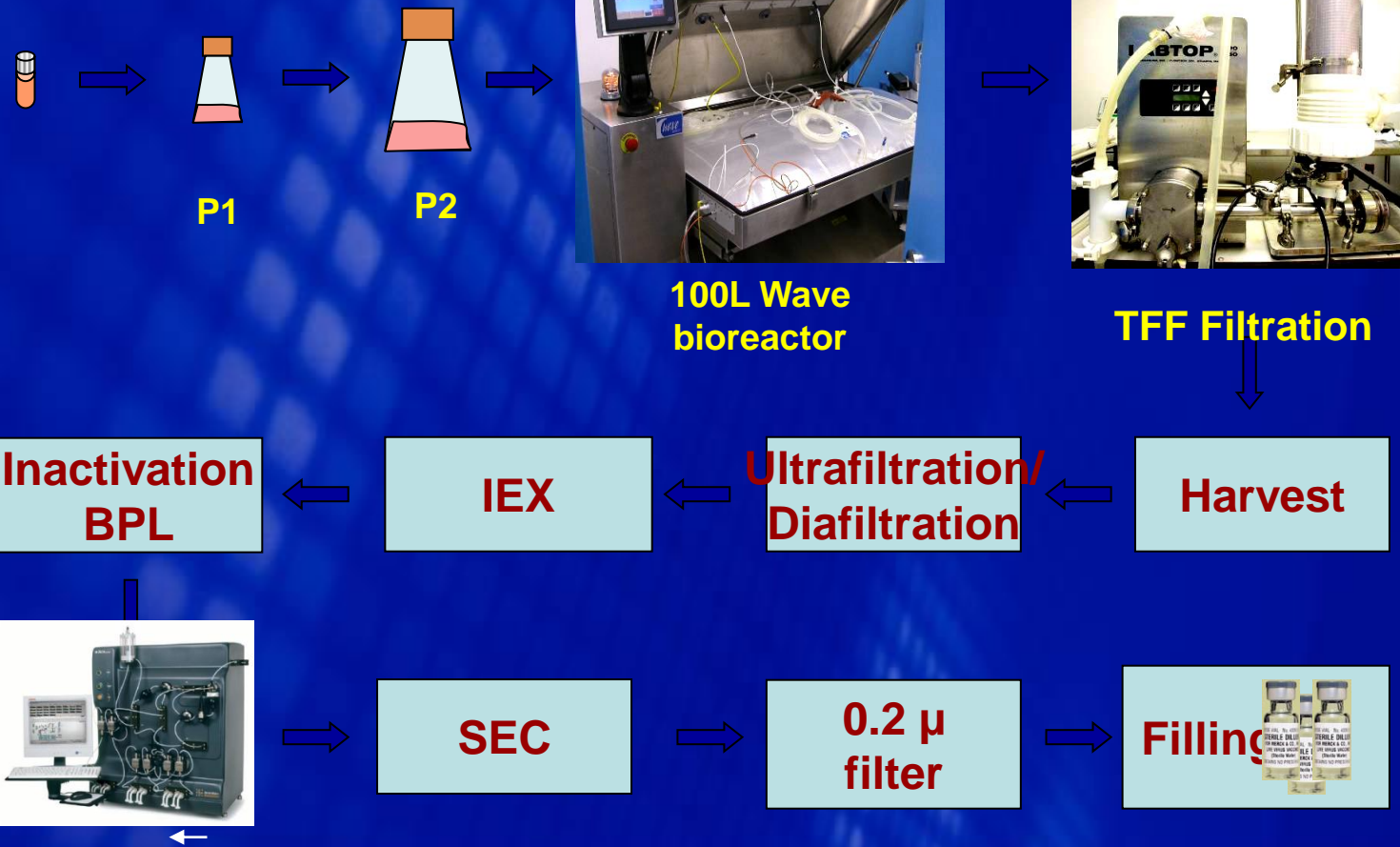
Implementation of a new functional modular facility ready within 1 year



Recombinant product-Process Flow Diagram



Overview of Manufacturing Process for Recombinant Influenza VLP Vaccines



Partnership in VLP technology platform

- Cadila/Novavax is open for joint venture/partnership in India and abroad for VLP based technology/product with different options-
 - Technology transfer
 - Joint development
 - Contract manufacturing
 - Product supply for CT and commercial





THANK YOU