

Next Generation Nuclear Power Plants

Ed Cummins

Westinghouse Electric Company

October 6, 2006

A Nuclear Renaissance is Beginning

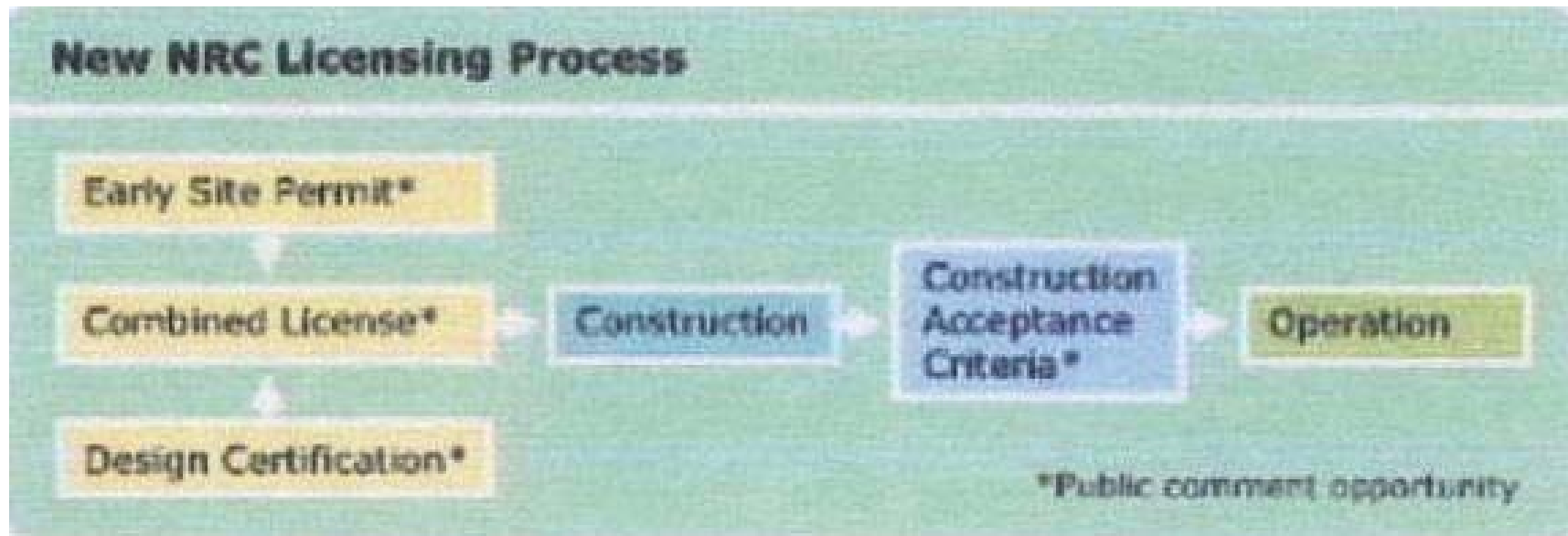


- Major Driving Factor
 - Price of natural gas more than doubled.
 - Volatility of natural gas prices
 - High long-term projections for natural gas prices
- Additional Considerations
 - Energy security
 - Uncertainty in the future emissions regulations (monetization of airborne pollutants such as carbon and mercury)
 - Availability of advanced nuclear plant designs
 - Relative stability of regulatory environment
 - Public policy (political) support (Energy Legislation in the U.S.)
- Challenges
 - Spent fuel disposal
 - Resource availability (human and supply chain)
 - Project Management

New Plant Licensing Process



- New NRC Licensing Process



AP1000 Design Certification Received From NRC 12/30/05



U.S. Government Support



“To build a secure energy future, we need to expand production of safe, clean nuclear power.”

President George W. Bush

New Plant Licensing Process



- Early Site Permit

- ESP is a partial construction permit .
- ESP addresses site safety issues, environmental protection issues and plans for coping with emergencies.
- Independent of the review of a specific nuclear plant design
- Three ESP applications submitted in 2003 (Dominion, Exelon and Entergy).
- Southern Company has submitted an ESP application

in August 2006.

New Plant Licensing Process Cont'd.



- Combined License (COL)
 - COL authorizes construction and conditional operation of a nuclear power plant.
 - COL application should include information required for a construction permit and operating license.
 - Must include the proposed inspections, tests and analyses which the licensee shall perform and associated acceptance criteria (ITAAC) .
 - The NRC must also find that the ITAAC have been met before

granting authorization to operate.

Nuclear Power 2010



- Dominion pursuing COL for ESBWR at North Anna.
- NuStart Project Status
 - Two sites selected for COL Application - Bellefonte (TVA) for AP1000 and Grand Gulf (Entergy) for ESBWR.
 - GE filed an application for design certification of ESBWR in August 25, 2005.
 - Design certification of AP1000 was issued in December 2005 .
 - Engineering work needed for COL applications under way.
- Submit COLs in the fourth quarter 2007.

United States New Plant Market Status



- Commitments for COL License

AP1000

NuStart (TVA)	2 units		
Duke	2 units		
Progress		2 units	North Carolina
Progress		2 units	Florida
SCANA	2 units		
Southern	<u>2 units</u>		
	12 units		

ESBWR

Dominion	2 units
Entergy	<u>2 units</u>
	4 units

EPR

Constellation	1-2 units
---------------	-----------

ABWR

South Texas	2 units
-------------	---------

Power Companies Evaluating Technology

Florida Power and Light
 AMEREN UE
 Texas Utilities
 Exelon (Texas)

- Strong preference for passive plants
- Preference for design and licensing maturity of AP1000

2005 Energy Policy Act



- President Bush signed the comprehensive energy bill into law, called 2005 Energy Policy Act. on August 8, 2005.
 - Nuclear Related Provisions
 - Federal risk insurance that would pay up to \$2B if there are delays in full power operations of the first six advanced power reactors receiving NRC's new combined construction and operating licenses. This covers 100% of the cost of delay for the first two new plants, up to \$500M each, and 50% of the delay costs up to \$250M each for plants three to six.
-

2005 Energy Policy Act Cont'd.



- Nuclear Related Provisions (continued)
 - Federal loan guarantee of up to 80% of the project cost.
 - Production tax credit for new reactors of 1.8 cents per kilowatts-hour for nuclear generated electricity over eight years. Implementing rules share benefits among qualifying new plant projects.
 - All decommissioning funds are taxed at 20% rate (reduced from the current rate).
 - Extension of Price-Anderson Act through 2025 (accident insurance).

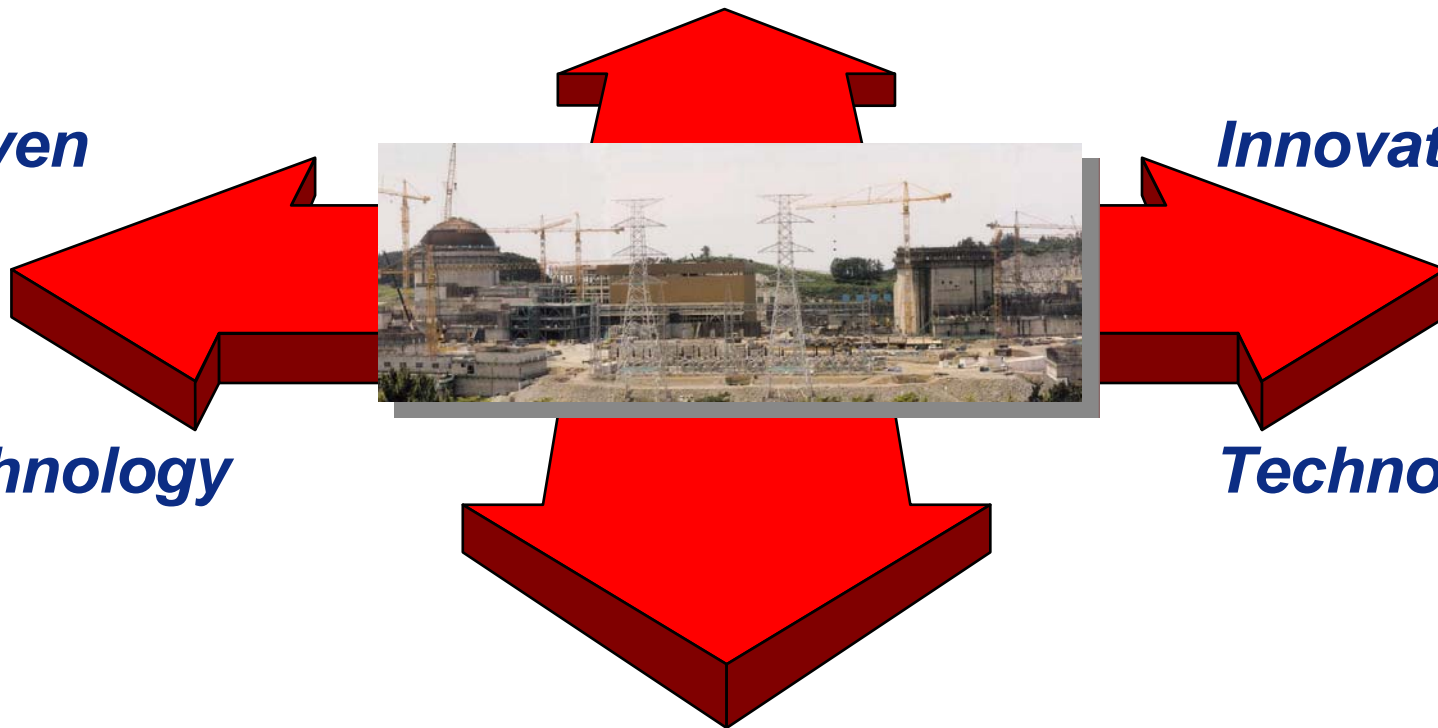
What Do Customers Want?



Large Plants

Proven

Innovative



Technology

Technology

Small Plants

Westinghouse Fifteen Year Investment in Passive Technology



- Westinghouse developed AP600, its first passive safety reactor

system in the early 1990s (1,300 man-years of design and testing).

- NRC issued AP600 design certification in 1999 following extensive

licensing review of more than 130 man-years and independent

confirmatory testing of critical systems.

- Westinghouse embarked on AP1000 development to improve cost

competitiveness.

AP1000: No Technology Risk



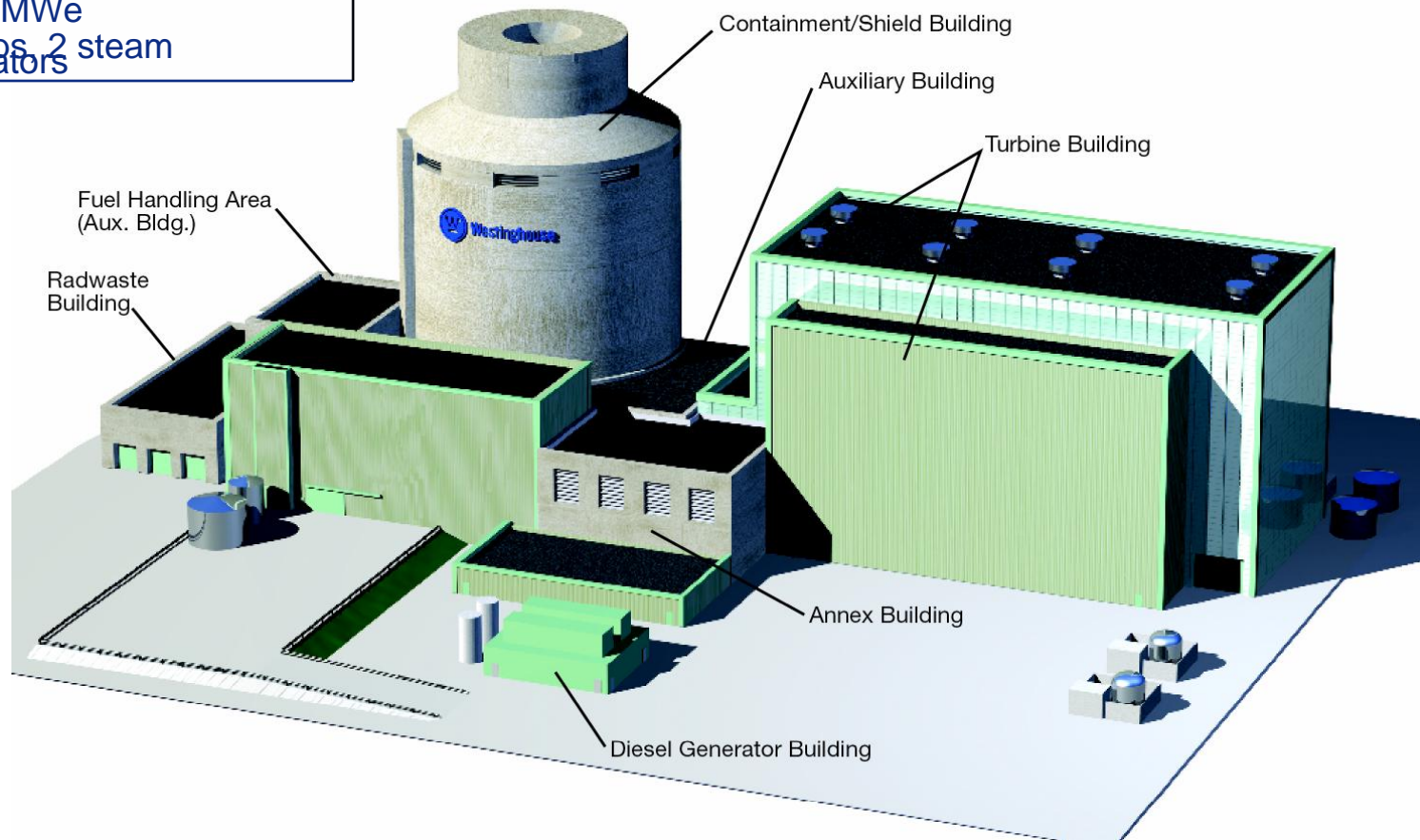
- AP1000 power generation systems (fuel, NSSS, turbine generator, support systems) are of “traditional design” and involve no new or novel technology. Operating experience is directly applicable.
 - “Passive” safety systems are, in general, very simple consisting largely of tanks, pipes and a few air or DC operated valves.
 - Expected performance under accident conditions validated by extensive testing (>\$40 MUSD) and regulatory review.
 - Modular construction techniques well proven in non-nuclear applications (ship building, off-shore drilling platforms)
 - Mature in design and licensing – 60% complete
-

AP1000 Design Features

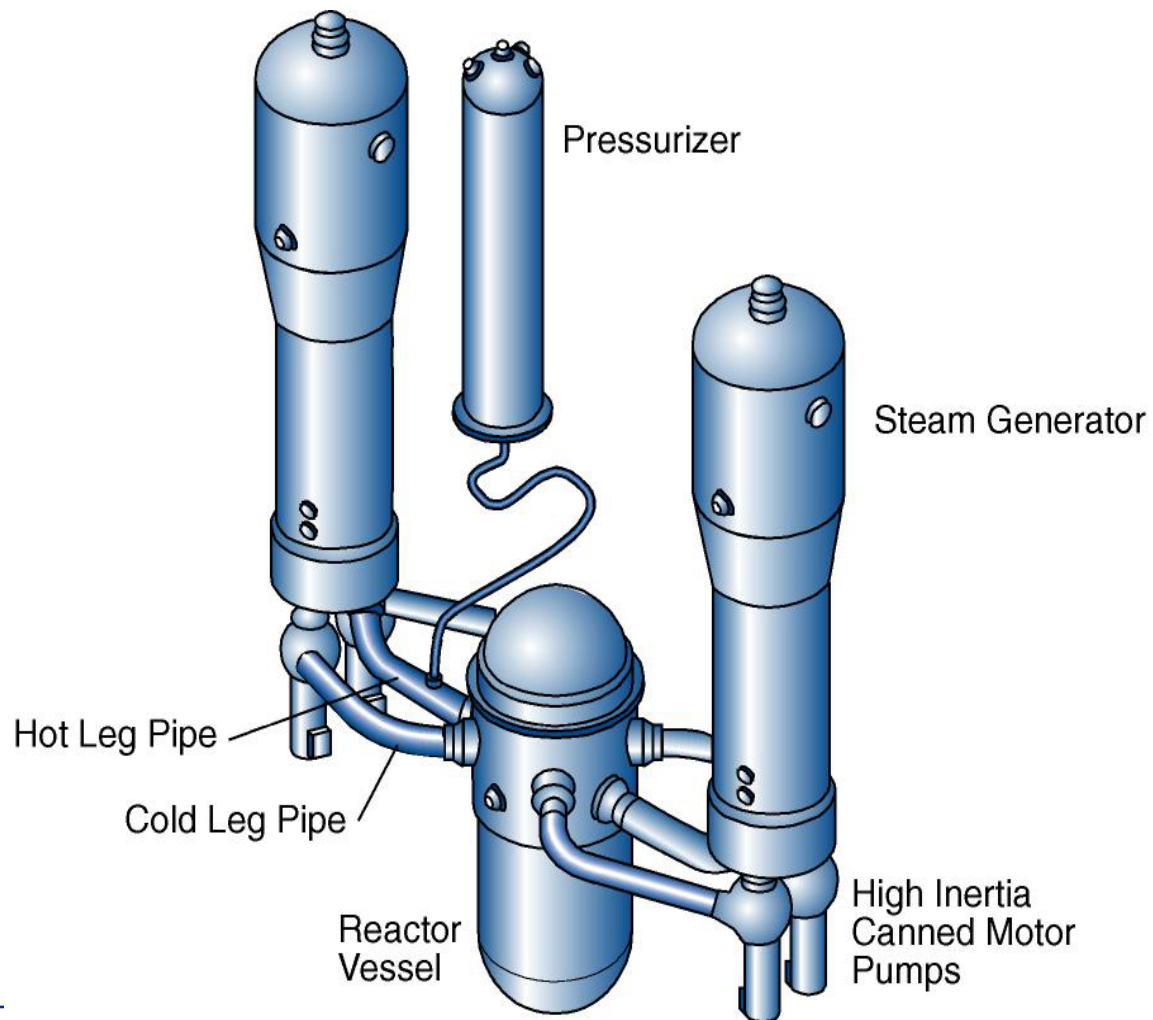
The Westinghouse AP1000



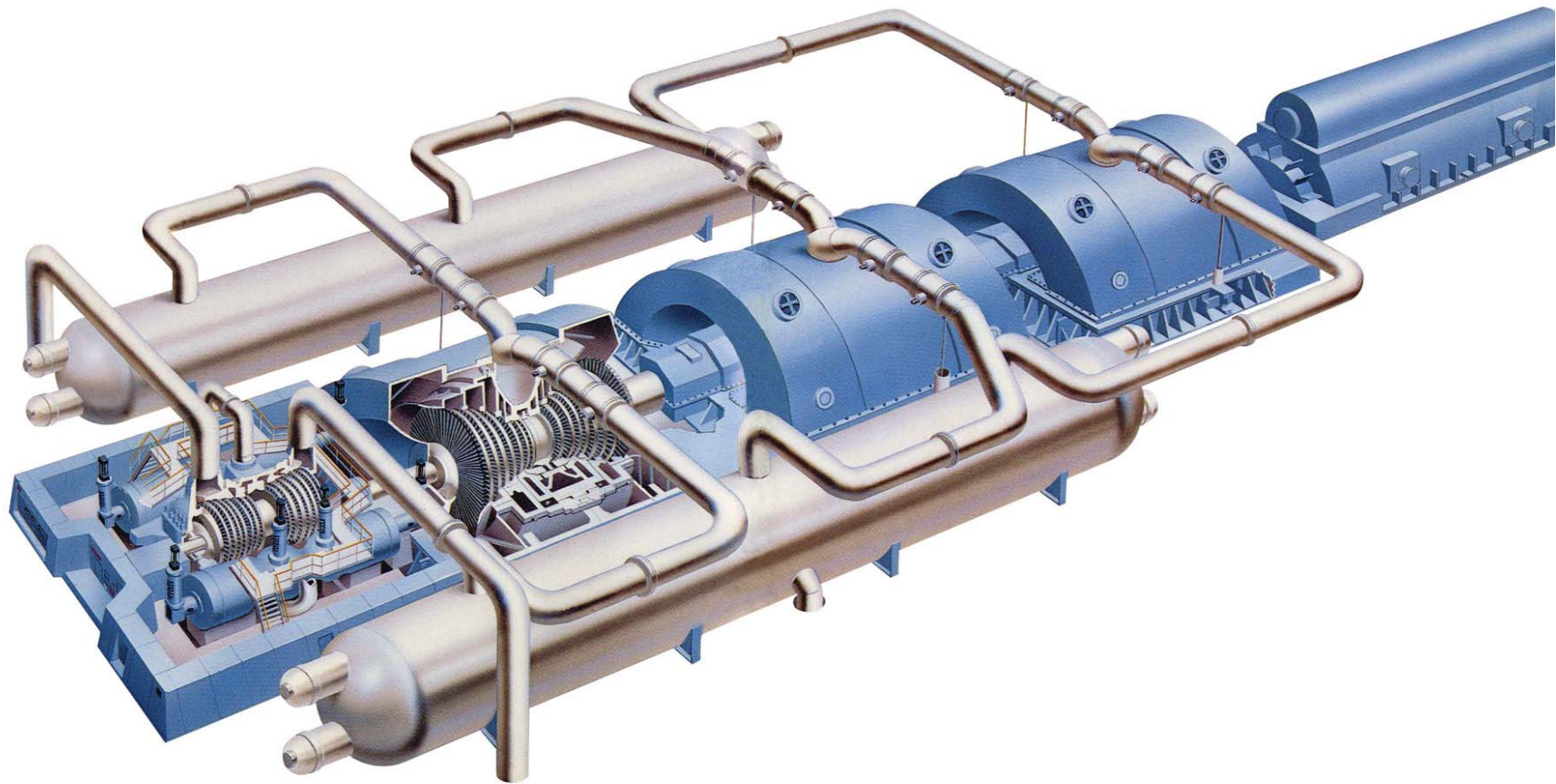
- A compact station
- 3415 MWt. Primary system
 - 1117 MWe
 - 2-loops, 2 steam generators



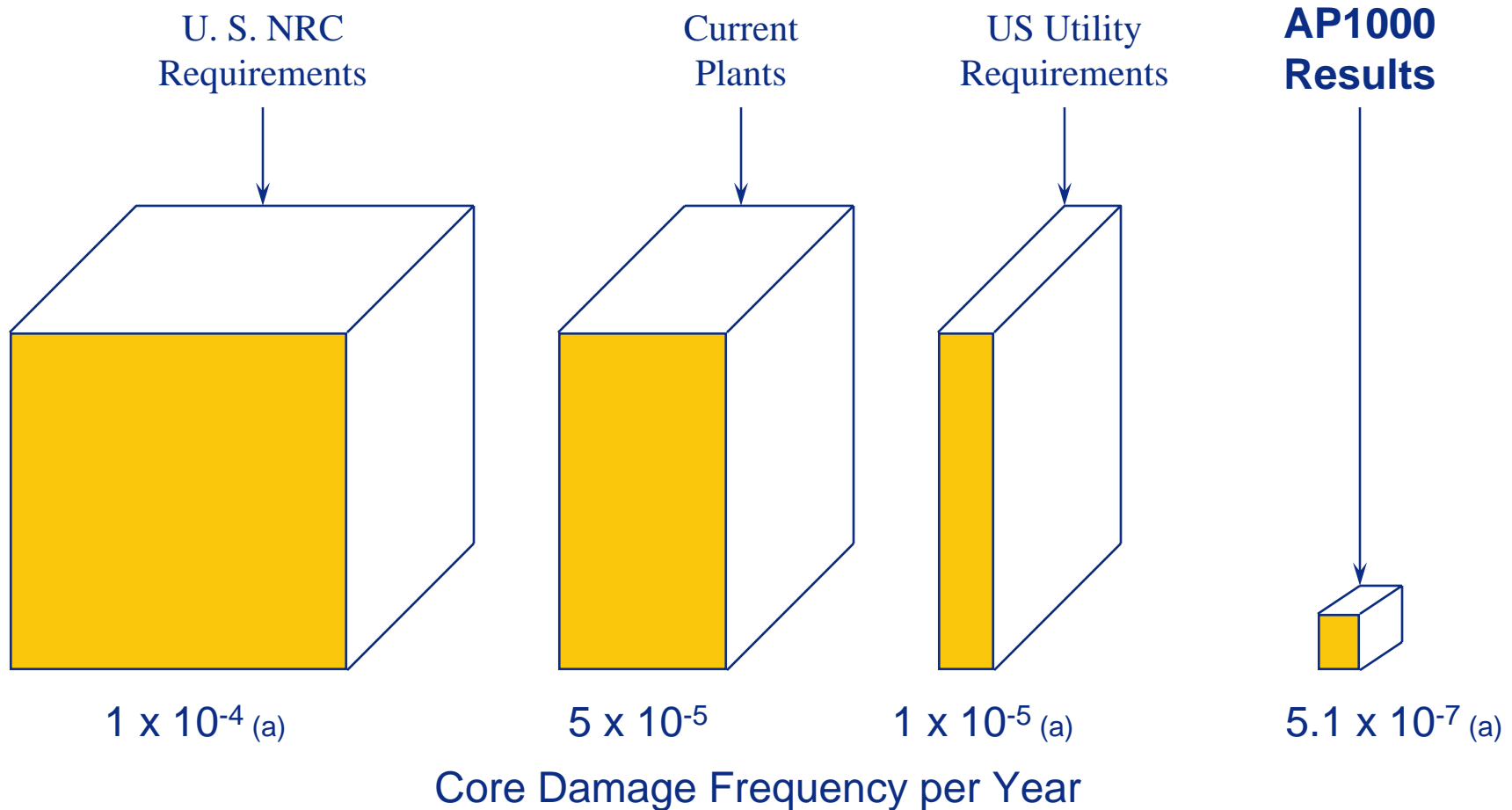
AP1000/AP600 Reactor Coolant System



AP1000 Turbine-Generator



AP1000 Provides Safety and Investment Protection

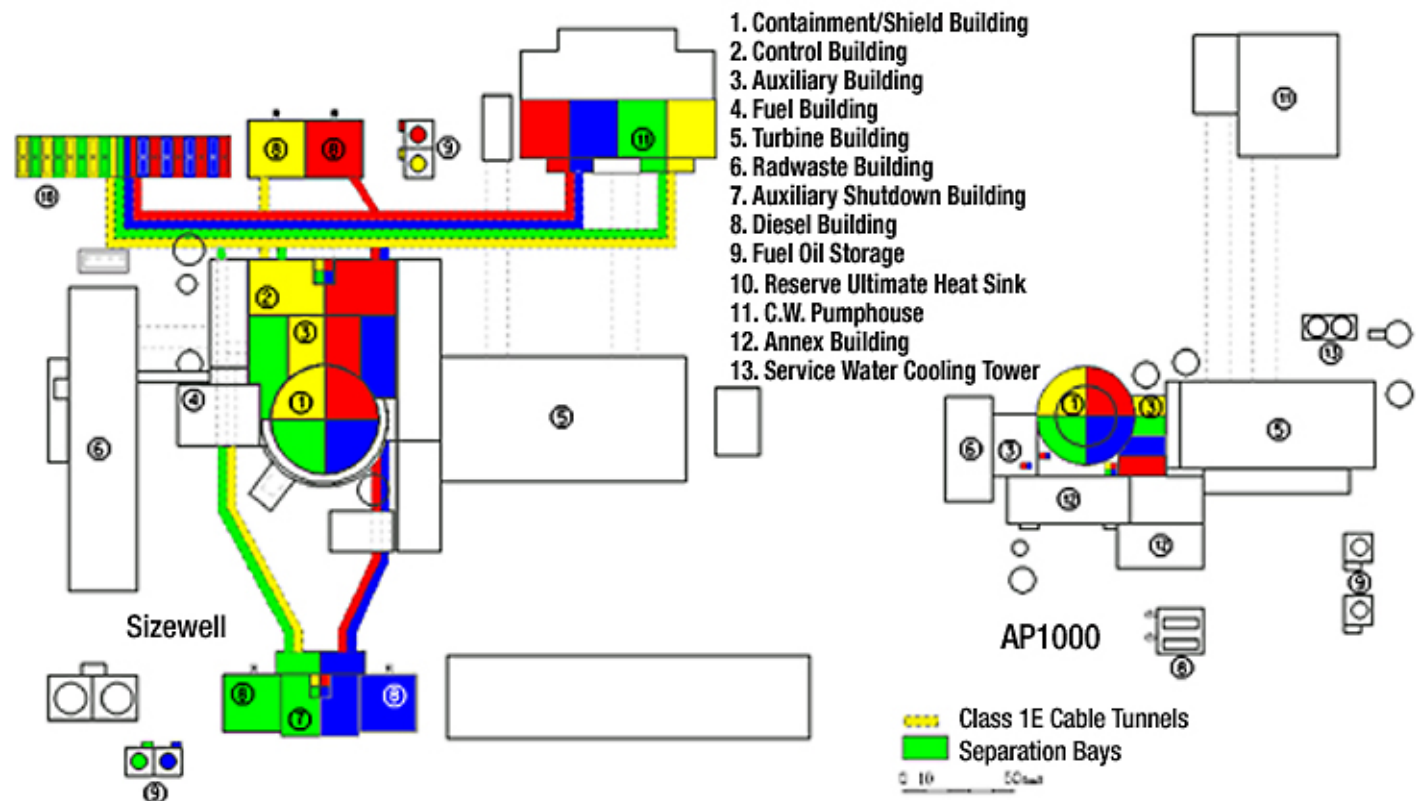


Note (a) CDF includes random and internal hazard events from at-power and shutdown conditions.

Passive Safety – What is it all about?

- Passive Safety Systems utilizes naturally occurring physical phenomena such as natural circulation of air, water and steam.
 - Gravity and gas pressure drive the flow of cooling water.
 - Natural heat transfer occurs through conduction, convection and evaporation.
 - Flow and cooling occur in accordance with nature's laws – There are no pumps and motor-operated valves.
 - A few valves align the passive safety systems upon actuation signals.
 - Greatly reduced operator dependency
 - AC electrical power is not required for plant safety.
-

The AP1000 is Smaller and Dramatically Simpler than Evolutionary Plants



Sizewell B

AP1000

7-11-17A

Next Generation Nuclear Plants?



- US licensing and construction of new nuclear plants, it will take a minimum of 9 years.
- Earliest practical commercial operation date for a new plant is in 2015.
- Plants that can be implemented prior to 2020 already have mature design and have initiated NRC licensing reviews.
- AP1000, ABWR - certified
 - ESBWR - certification in process
 - EPR, APWR - plans for certification announced
- Next Generation Nuclear Plants are those that the industry has been designing for the last 15 years.
- Investment in Design is on the order of \$500M over 15 years.
- Investment in licensing is more than \$50M over 5 years.

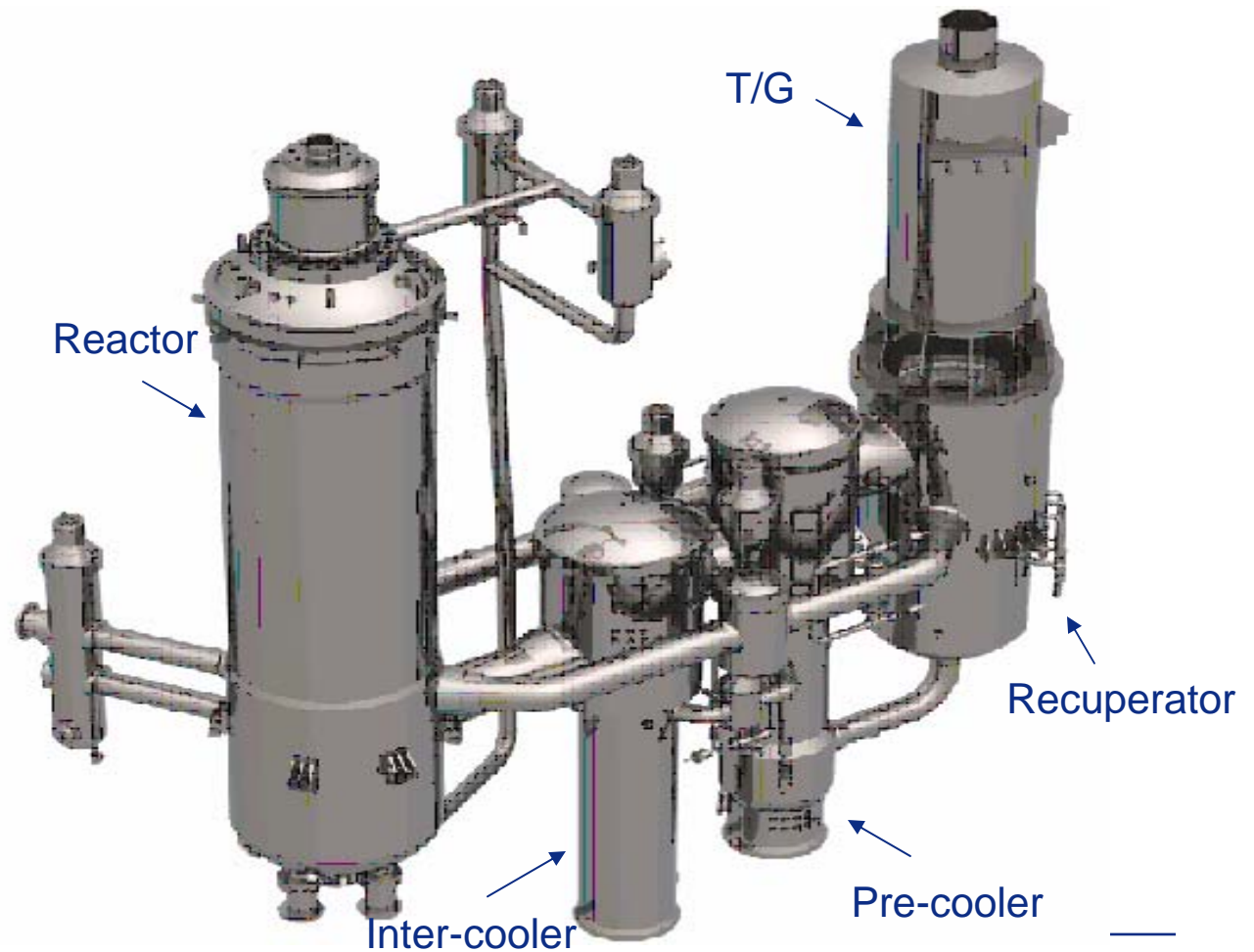
New Designs



- GNEP targets initial plant by 2021.
- PBMR is on a development path with 5+ years of development worth hundreds of millions of dollars.
- Most other designs are conceptual and are studying the basic science.
- New designs are realistically available only for our children's children.
- The Next Generation has a choice of designs that were conceived in the 1980's.
- Designs conceived in this decade will not be licensed and commercialized until the mid-2020's.

Pebble Bed Modular Reactor (PBMR) **AP1000**

- Small High Temperature (900°C) Helium Cooled Reactor (165 MWe)
- Fuel in Spherical Fuel Elements

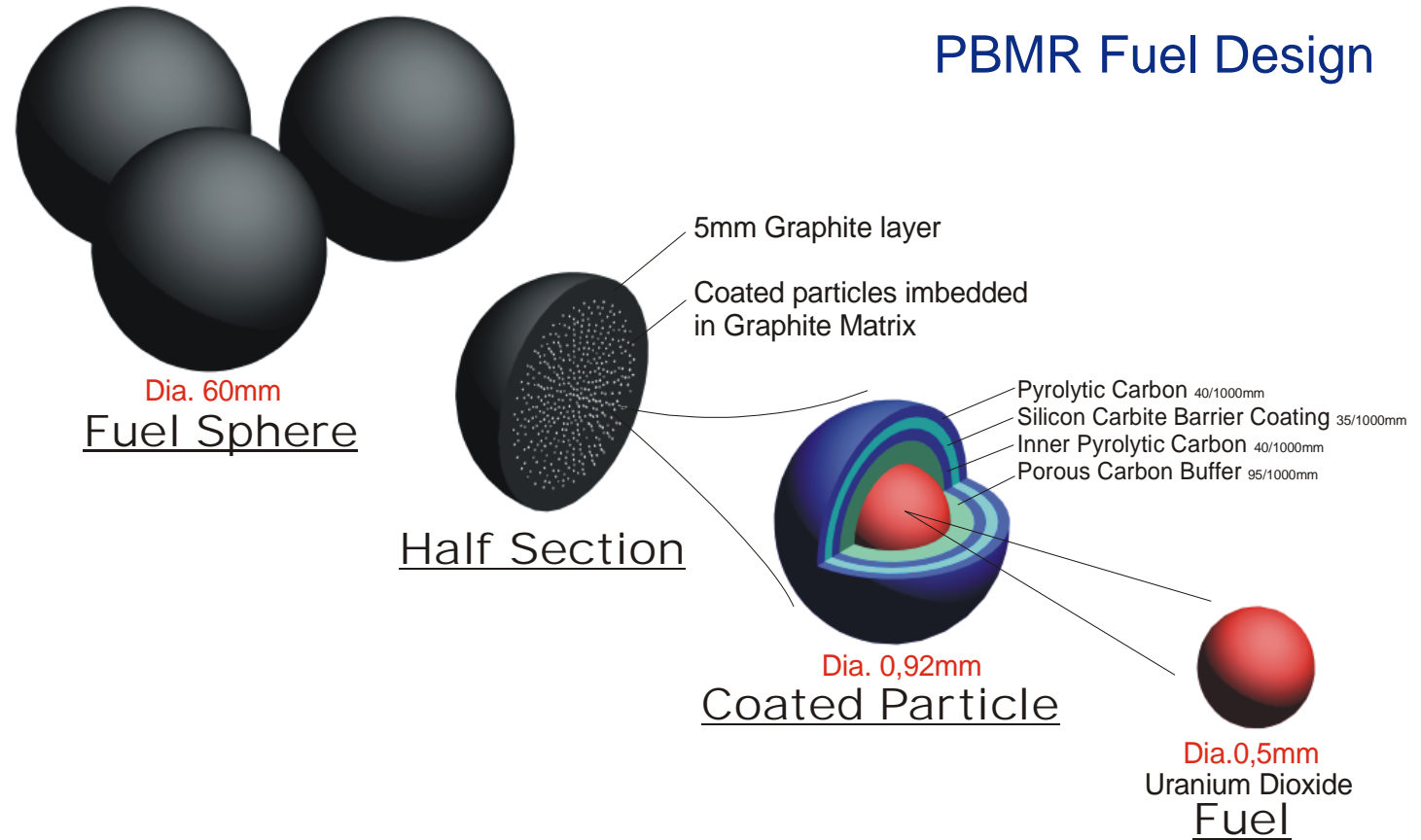


Fuel Element Design for PBMR



PBMR Fuel Design

- Primary barrier (ceramic coated fuel particles) retains radioactive nuclides



Conclusions



- AP1000 has been developed by the nuclear industry over a 15 year period.
- AP1000 received Design Certification from the US NRC in December 2005.
- AP1000 is mature and ready for commercialization.
- AP1000 is pursuing closure of open items for the combined operating and construction license from the NRC.
- AP1000 is a nuclear plant for the Next Generation.
- There are alternative plant designs with varying licensing and design maturity which are also available.

-
- Truly, new nuclear plant concepts may provide power for our children's

