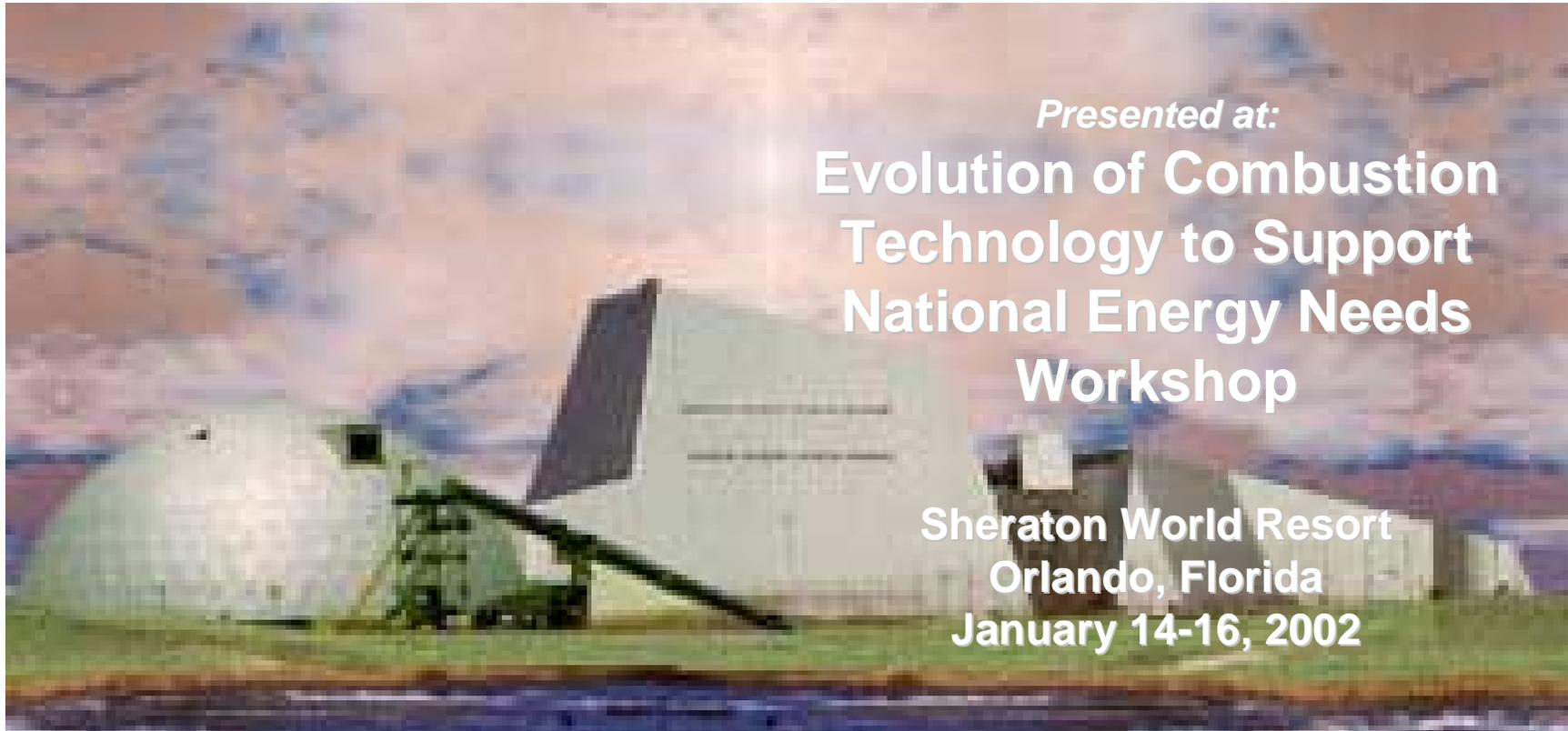


# Advanced Combustion Technology Is Insurable



*Presented at:*  
**Evolution of Combustion  
Technology to Support  
National Energy Needs  
Workshop**

**Sheraton World Resort  
Orlando, Florida  
January 14-16, 2002**

**Richard E. Weinstein, P.E.**

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# Acknowledgements

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*particular thanks for information from:*

- Brian W. Moore,
- Bob Hartranft, and
- David L. Holt



***The problem with pioneering  
new coal-fired power  
generation technology...***



*“Typically,  
the pioneers  
take the  
arrows.”*

**Gary Stein**, General Motors Energy Director  
Private Power Executive. March-April 1994



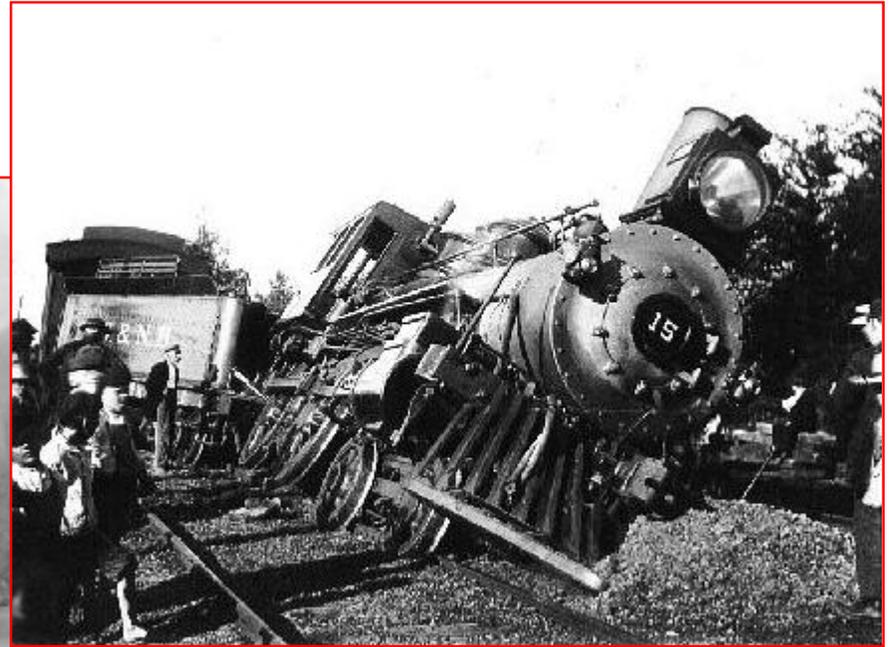
St. Sebastian, Set design for "Nick and Nora", Broadway, 1991



***So, how do you overcome ...***



# FEAR: After All, What if it Doesn't Work?



**Worried? You can place a dollar value on the risk.**

**System Performance Insurance will place a dollar value on the risk to assure the decision-maker.**



## **This Paper's Conclusions - *Why Wait?***

- **Pioneering a new technology holds risk...**

***BUT...***

- **Underwriters can and will insure that a new advanced coal combustion technology project provides equipment that meets system performance guarantees, or they'll fix it so it does**
- **Risk is both manageable, and with good design, the exposure to financial risk can be low**
- **Early attention to managing risk leads to improved lower-risk design**
- **The next generation of advanced combustion electric power plants will combine jet engines with coal**  
***...and can keep risk under control***

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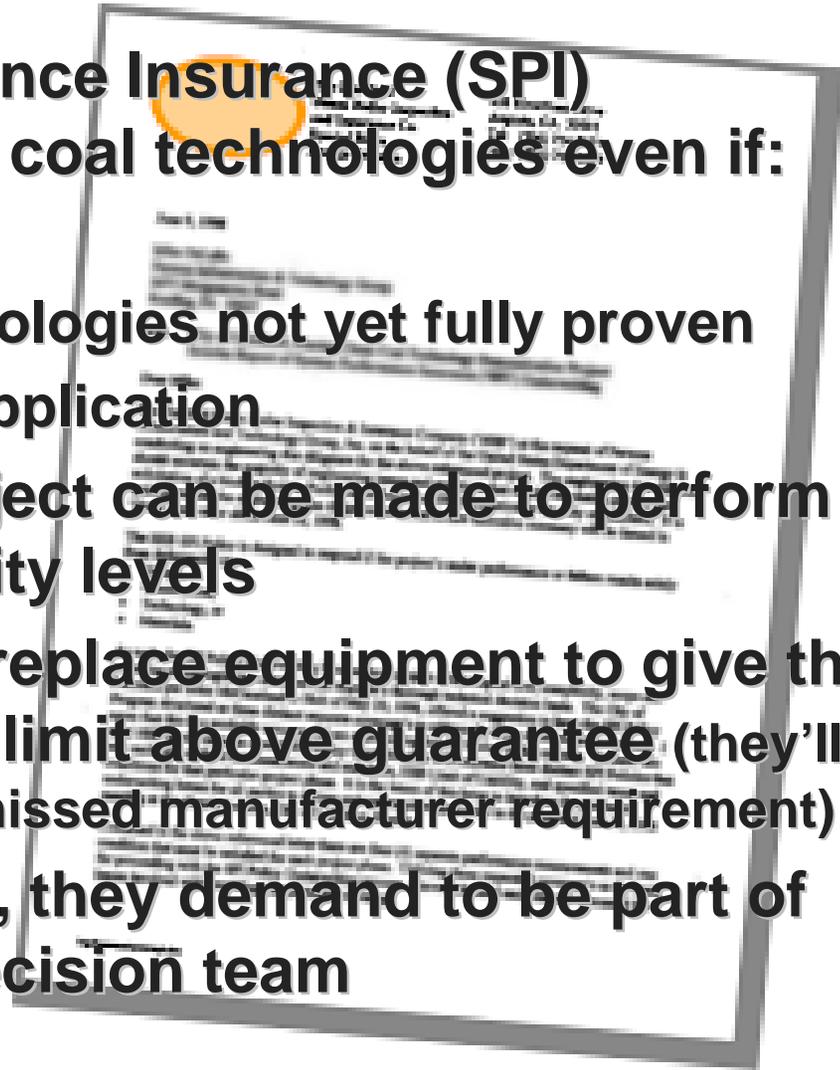
## CCT Case Study Example

- Recently, a clean coal technology project was reviewed by a major insurance company, and that underwriter found the technical risks insurable
- This project considered advanced circulating pressurized fluidized bed combustion combined cycle technology (APFBC)
- This project is used here as an example of how advanced coal projects can insure the owner's investment in the technology will work

**This paper looks at how an underwriter views such projects**

## An Underwriter Will...

- Write a **System Performance Insurance (SPI)** agreement for new clean coal technologies even if:
  - complex
  - involves emerging technologies not yet fully proven
  - involves first-of-a-kind application
- They assure that the project can be made to perform to heat rate and availability levels
- They agree to modify or replace equipment to give the equivalent of a specified limit above guarantee (they'll guarantee an offset above a missed manufacturer requirement)
- To protect their interests, they demand to be part of the design review and decision team

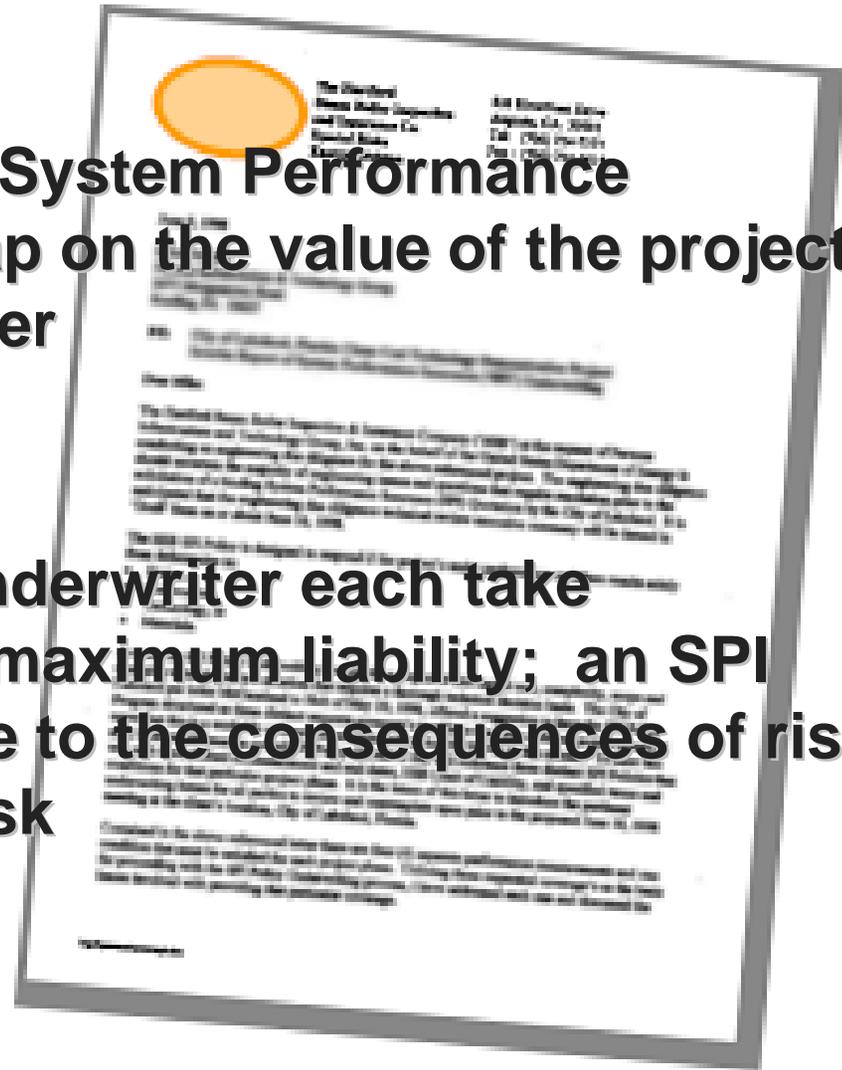


## Owner Risk Isn't Eliminated, But...

- An “up front” fee for the **System Performance Insurance (SPI)** puts a cap on the value of the project risk exposure to the owner

still...

The manufacturer and underwriter each take positions that limit their maximum liability; an SPI greatly reduces exposure to the consequences of risk but does not eliminate risk



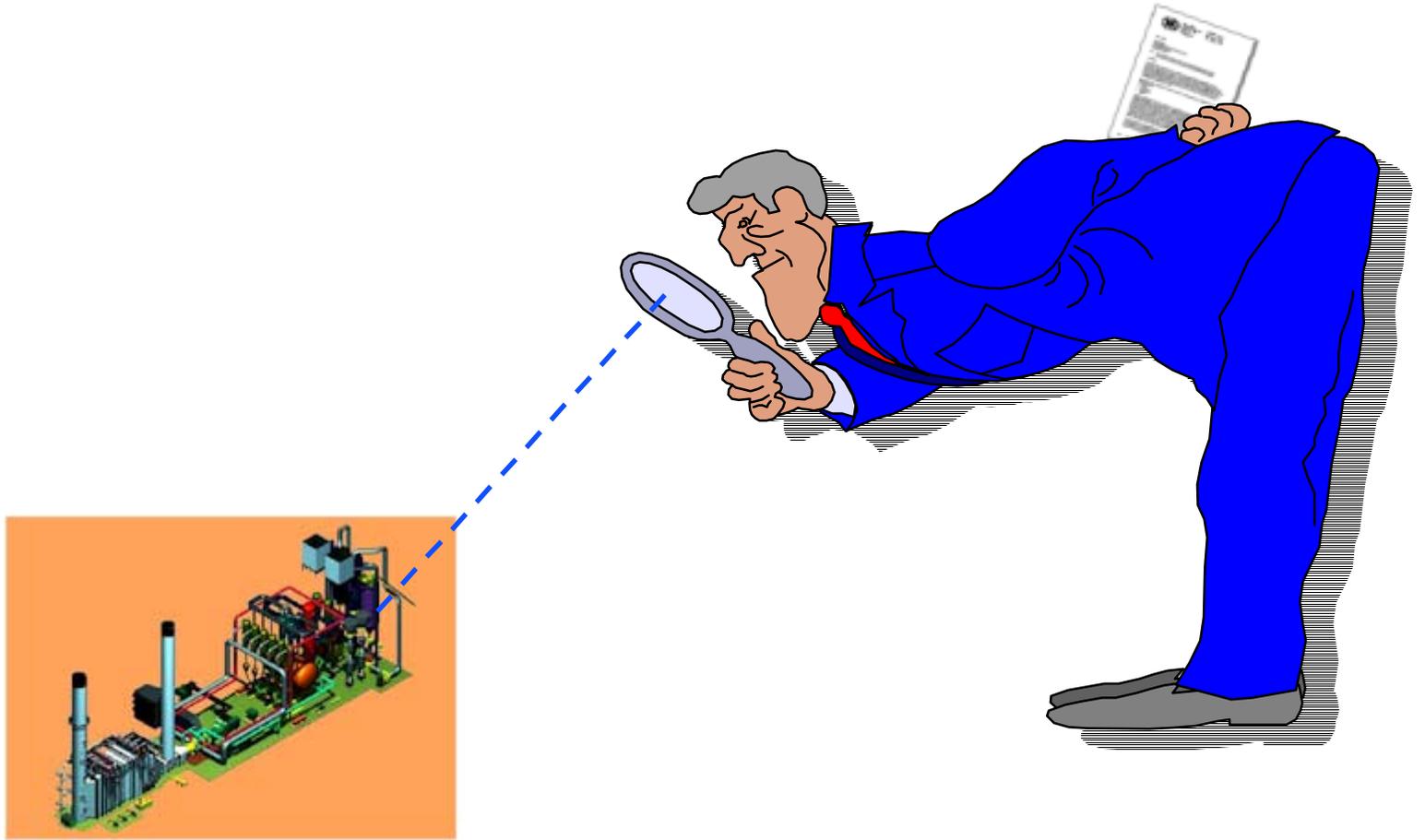
# What Does the Underwriter's **SPI Policy** Do?

*Responds to a project's under performance or failure results from deficiencies in:*

- Design
- Construction
- Technology, or
- Materials



...System performance insurance is usual with fully developed technology projects, ***BUT can also be written for first-of-a-kind projects using technology with only limited commercial experience***



## What Does the Underwriter Look At For Emerging Technology Projects?

# Technical and Commercial Issues Which Affect the Whole Program or Plant



# Underwriters Investigate Contract Relationships

- **Arrangements Between Financial Partners**
- **Owner / Operator (if different)**
- **Owner / Prime Manufacturer**
- **Manufacturer/Major Equipment Suppliers**
- **Responsibilities: recourse, warranties, other guarantees**
- **Budget authorities**

---

# Project Schedule Needs

- Regular Update needed
- More clarity on major components,  
*...in the example project their concern was especially that for the gas turbine*
- More detail on test schedules

---

# Component and System Tests

- Overall testing plan
- Specific tests and procedures
- Interpretation and distribution
- Feedback and corrective action

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# Spares Support

- **Routine spares definition**
- **One-of-a-kind spares program**
- **Multi-plant agreements**

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# On-Site Support

- **Plant- and component-specific programs**
- **Specific or typical individuals**
  - Major suppliers
  - Industry consultants

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# Assessment of Equivalent Availability Factor

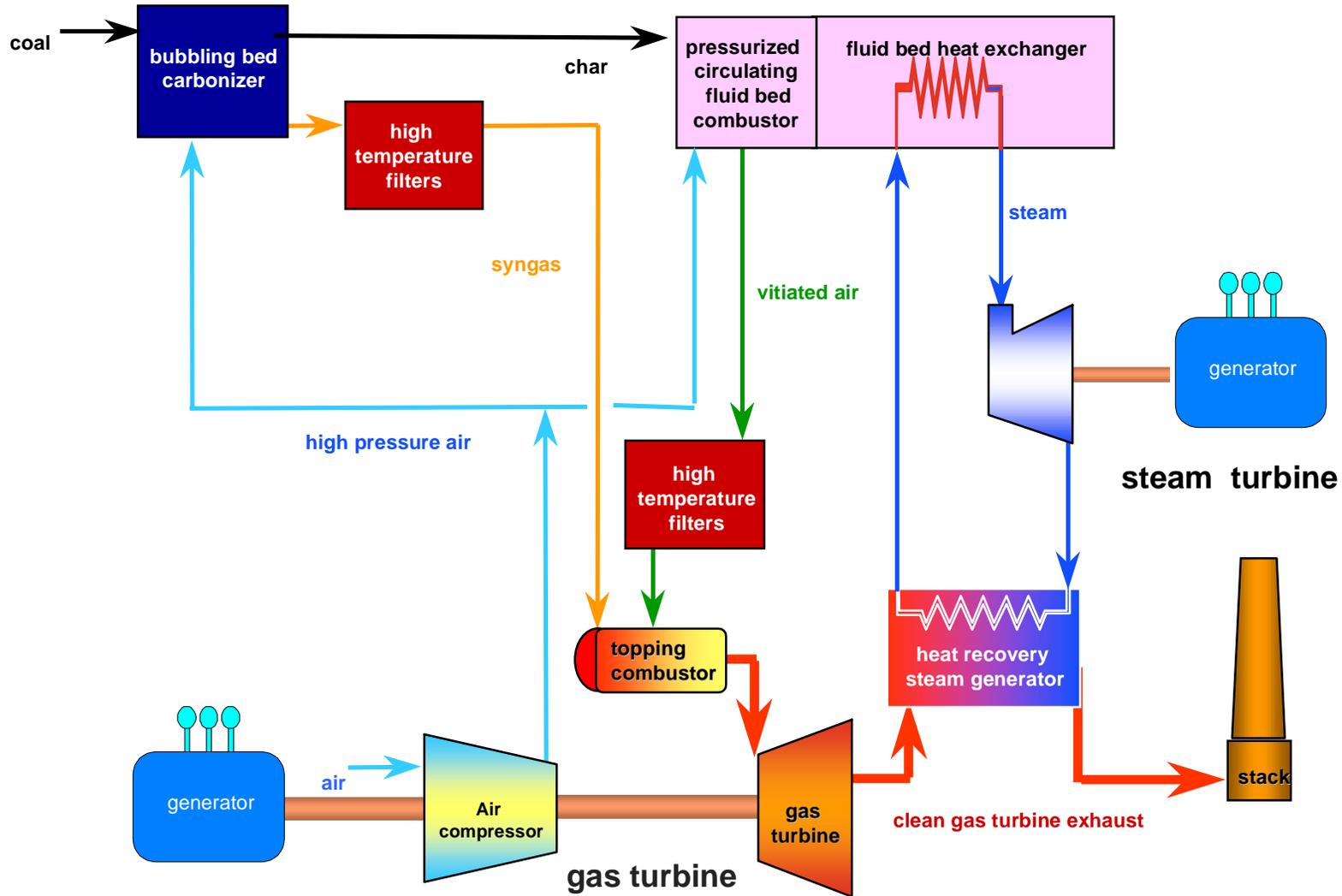
- **“Bottom up” analysis**
- **“Top down” comparisons:**
  - Experiences with earlier Clean Coal units
  - Recent manufacturer experience with similar/related technology units
  - Experiences with other coal units operated by the power plant owner

# Clear Delineation of Operating Responsibilities and Assessment of Their Capability

- **Organization chart**
  - Name
  - Company
  - Operational and budget authority
- **Experience on comparably complex units**



# Our Example: Advanced Circulating Pressurized Fluidized Bed Combustion Combined Cycle (APFBC)



# COAL COMBUSTION ISSUES - Systems



- PCFB
- CARBONIZER
- CANDLE FILTERS
- CONTROLS
- HRSG (HRU)
- INTERCOOLER

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# COAL COMBUSTION ISSUES - General

- **General Issues**

- Failure Mode Effect Analysis (FMEA - component/system)
- Design and testing codes
- Miscellaneous (basic control block diagrams, recovery from upsets)

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# PCFB

- **Fluidized bed operations**
- **Fuel and sorbent feed, size, and selection**
- **Bed mixing**
- **Bed sintering**
- **Ash removal from cyclone and bed**
- **Heat transfer rates (HT Surface Sizing and Placement)**
- **Eutectic ash formations**

# PCFB

<b>Area(s) of Concern</b>	<b>Risk/ Problem</b>	<b>Level of Risk</b>	<b>Risk Reduction Approach</b>

---

# **Risk in Incompletely Defined Technical Issues**

- **Some data does not exist yet**
- **Some data is partially completed**
- **Some data supplied was not requested clearly or the response was not complete enough**



## Level of Risk

The underwriter will independently assign a risk level:

- Critical
- Extremely Significant
- Very Significant
- Significant
- Moderate

## PCFB (cont'd)

<b>Area(s) of Concern</b>	<b>Risk/ Problem</b>	<b>Level of Risk</b>	<b>Risk Reduction Approach</b>
<b>Coal Feed and Preparation System</b>	<b>Plugging and particle sizing</b>		<b>Need to address Preventative Maintenance/ Sparing Controls</b>
<b>Limestone Feed and Prep System</b>	<b>Plugging and particle sizing</b>		<b>Need to address Preventative Maintenance/ Sparing Controls</b>
<b>Ash Removal Systems</b>	<b>Cyclones Bed Ash</b>		<b>Design review of Controls, Particle Size</b>



# Combustion Turbine/System Technical Evaluation Issues



- Topping Combustor
- Gas Turbine
- Turbine Protection

# Plant Level

## Overall Plant Level Technical Evaluation Issues

Performance

Emissions

Availability/Reliability

O&M Costs

Integration



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# RECOMMENDATION

## How to Respond

- NO: This is not a concern.

...or...

- YES: For this engineering reason or from these experiments or experiences...



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# Overall Results

- **Majority of key engineering issues were identified**
- **Proposed plan of SPI coverage prepared by the owner**
- **Proposed action plan to address both engineering & underwriting issues needed to be finalized**

---

# Key SPI Policy Terms & Conditions

- **System performance guarantees requested for:**
  - Plant MWe Output
  - Plant Heat Rate
  - Equivalent Availability
  - Emission Requirements
- **All subject to project time line**

# Insuring Plant MWe and Heat Rate

- **Output - MWe @ >90% of design basis**
- **Heat Rate @ <105% of design basis**
  - Acceptable starting negotiation points
  - Overall Integration of the plant design was of critical concern
  - Time line at which the facility will achieve the levels was also major issue

# Insuring Equivalent Availability Factor

- **Phase I, 75 % for 30 Day Period**
  - **Phase II, 80% for 6 Month Period**
  - **Phase III, 80% for 12 Month Period**
- Routine for Commercially Proven Designs
  - Project Involves 4 New Technologies
    - All are required to perform
    - At this point difficult to establish time line for achieving of the above requested goals

# Insuring Emission Requirements Open to Negotiation

- **Coverage for Project to meet agreed to emission levels**
  - Emission levels unknown at this time so evaluation was not possible
  - *The Underwriter typically excludes this coverage*
  - Understanding and evaluation process may allow for coverage, premature at this time to deny or commit to coverage

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# Key Underwriting Issues

- **Utilization of NEPA permitting process time to resolve engineering issues**
- **Underwriter support during this process**
- **EPC & subcontract agreements**
- **Establishment of net present value of failure to achieve a performance criteria**

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## **Proposed Plan of Action**

- **Ascertain the level of commitment the owner required from the Underwriter to pursue the project**
- **Evaluate the engineering issues and determine feasibility of resolution**
- **Determine the Underwriter's role during NEPA process required to satisfy SPI requirements and establish a plan on how to accomplish them**

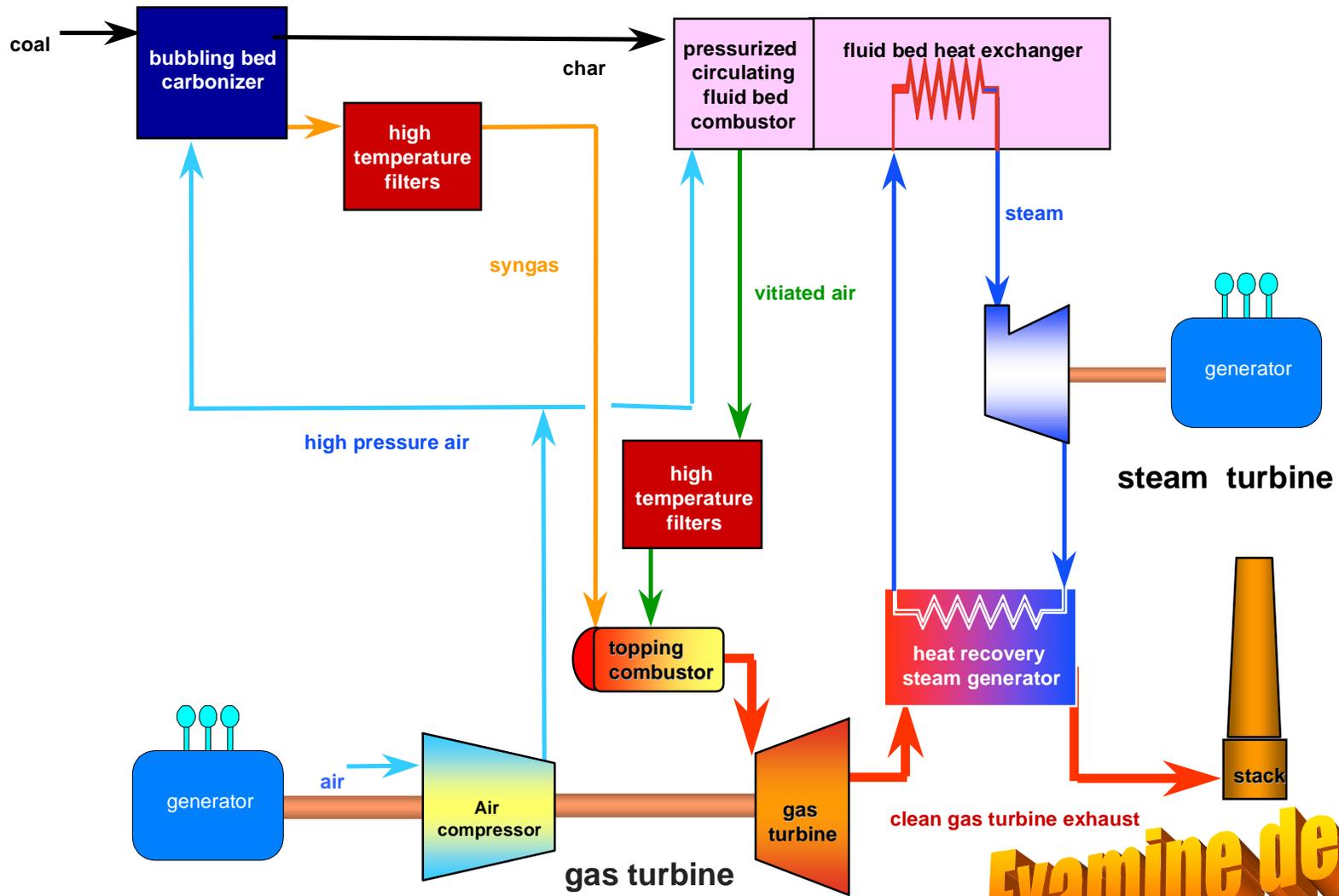
# The Evolution of Design

**Assessment of risk leads to lower risk design...**



# 2<sup>nd</sup> Generation PFBC

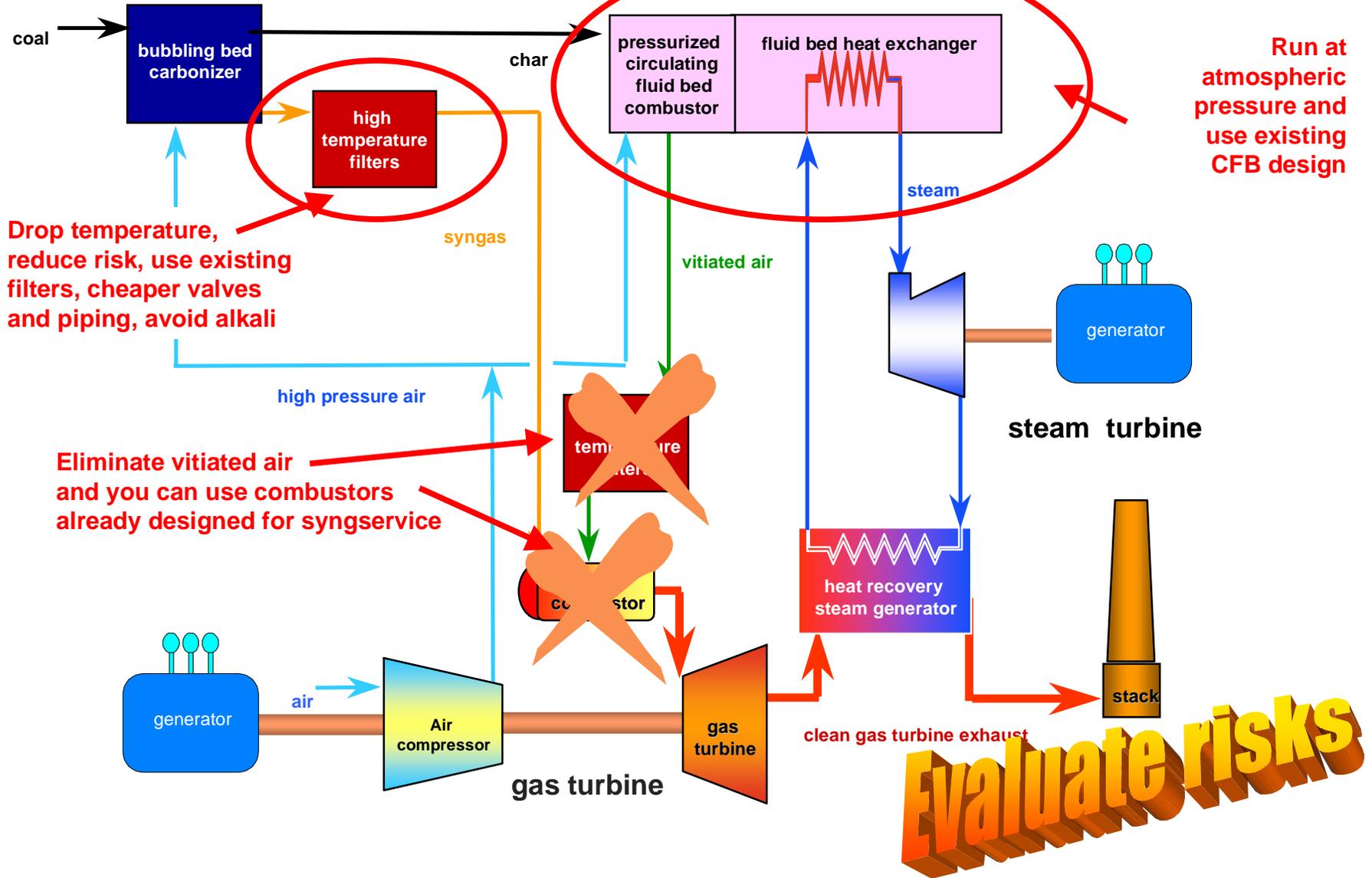
advanced circulating pressurized fluidized bed combustion combined cycle (APFBC)



**Examine design**

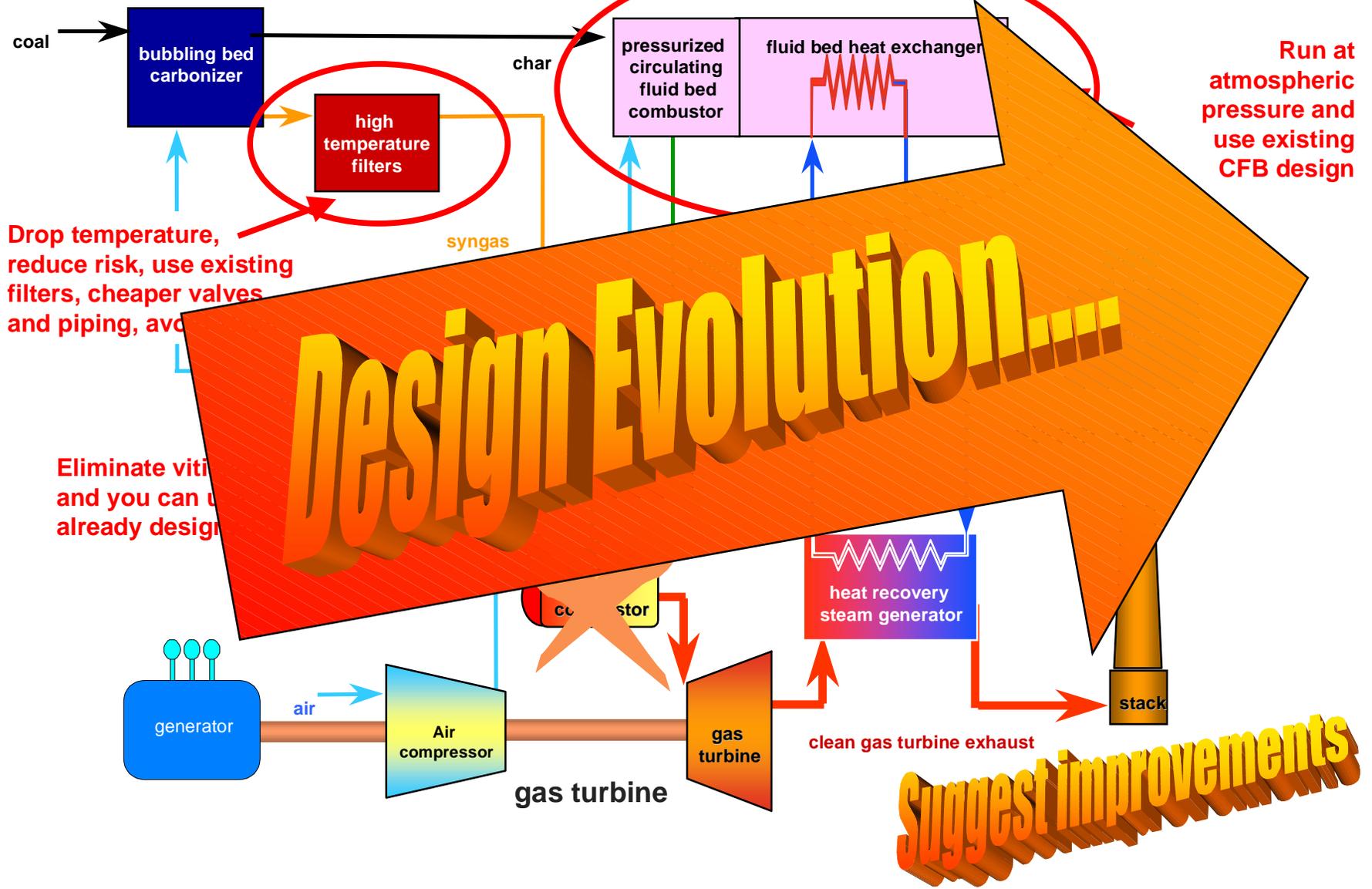
# 2<sup>nd</sup> Generation PFBC

advanced circulating pressurized fluidized bed combustion combined cycle (APFBC)

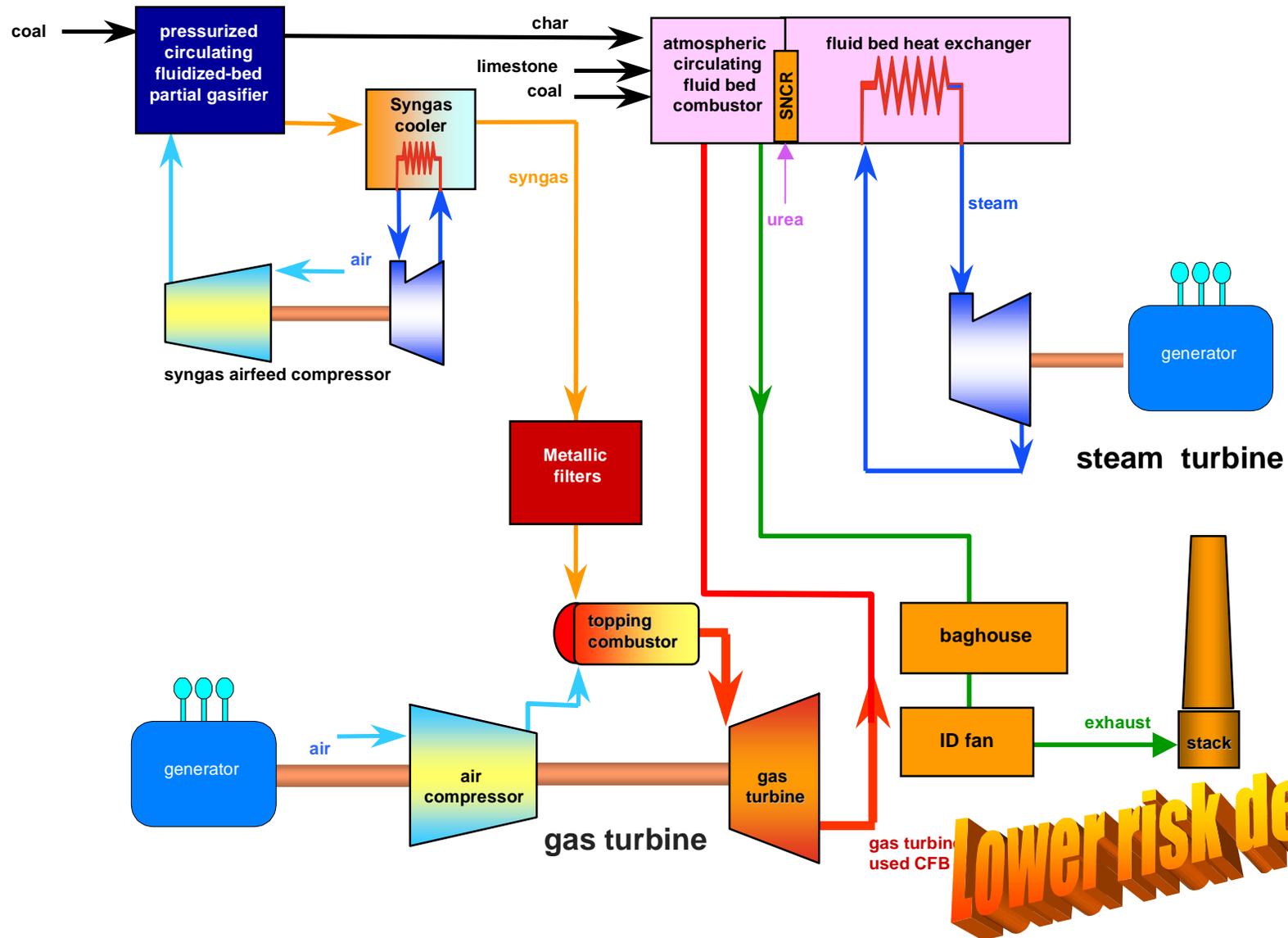


# 2<sup>nd</sup> Generation PFBC

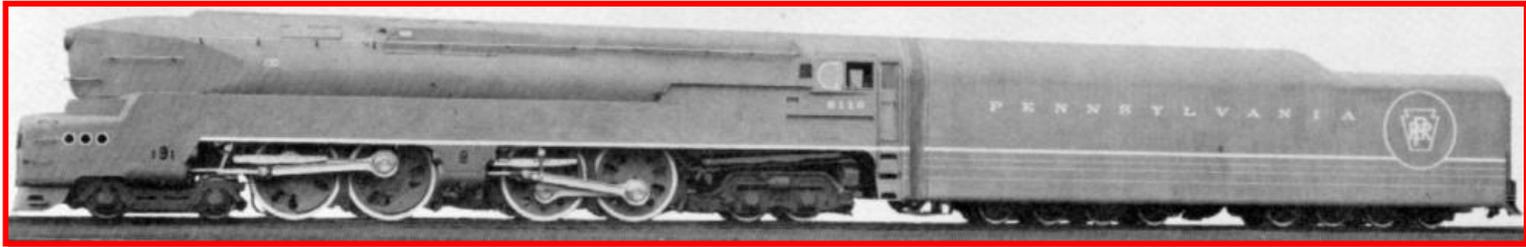
advanced circulating pressurized fluidized bed combustion combined cycle (APFBC)



# Gasification Fluidized Bed Combustion Combined Cycle (GFBCC)



# Its Time to Get New Technology Back On Track: New Clean Coal Technology ***IS*** Insurable



*The mighty Pennsylvania T1 steam locomotive, the pinnacle  
of steam locomotive design*



**Design Evolution...**

The next generation of advanced  
combustion electric power plants  
combine jet engines with coal...

*...with risk kept under control!*



*The opinions expressed are the author's, and  
do not necessarily reflect those of the Underwriter.*