

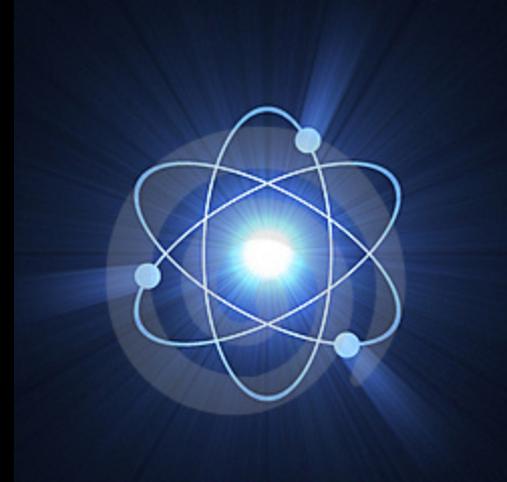
# Written Exam Question Plausibility



Presented  
by  
Ron Aiello



# Discussion Categories



- **How are implausible distractors identified?**
- **Examples of implausible distractors**
- **Examples of some good distractors with supporting documentation**

# Just Think, What Kind of Plausible Questions Could Be Written from the Following Accident Report?



- Just in case you thought you were having a BAD day...
- This is a bricklayer's accident report that was printed in the newsletter of the English equivalent of the workmens' compensation board.

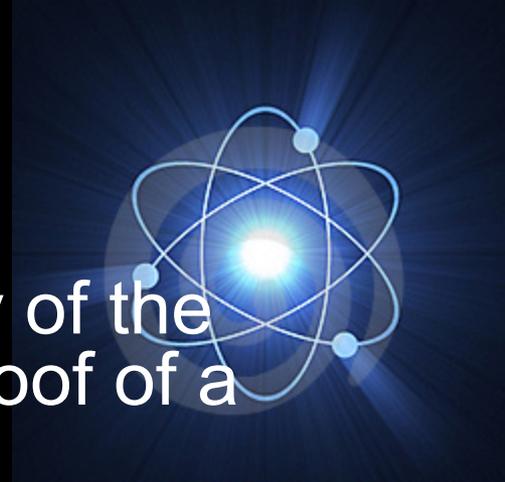
Dear Sir:



I am writing in response to your request for additional information in block #3 of the accident reporting form.

I put "poor planning" as the cause of my accident.

You asked for a more detailed explanation and I trust that the following details will be sufficient.



I am a bricklayer by trade. On the day of the accident, I was working alone on the roof of a new six story building.

When I completed my work, I found that I had some bricks left over which when weighed later were found to weigh 240 lbs.

Rather than carry the bricks down by hand, I decided to lower them in a barrel by using a pulley which was attached to the side of the building at the sixth floor (see exhibit "A").

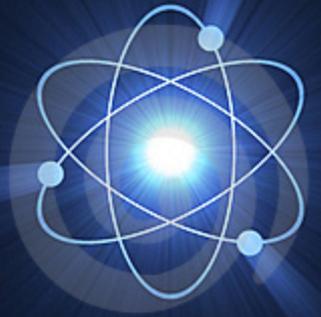
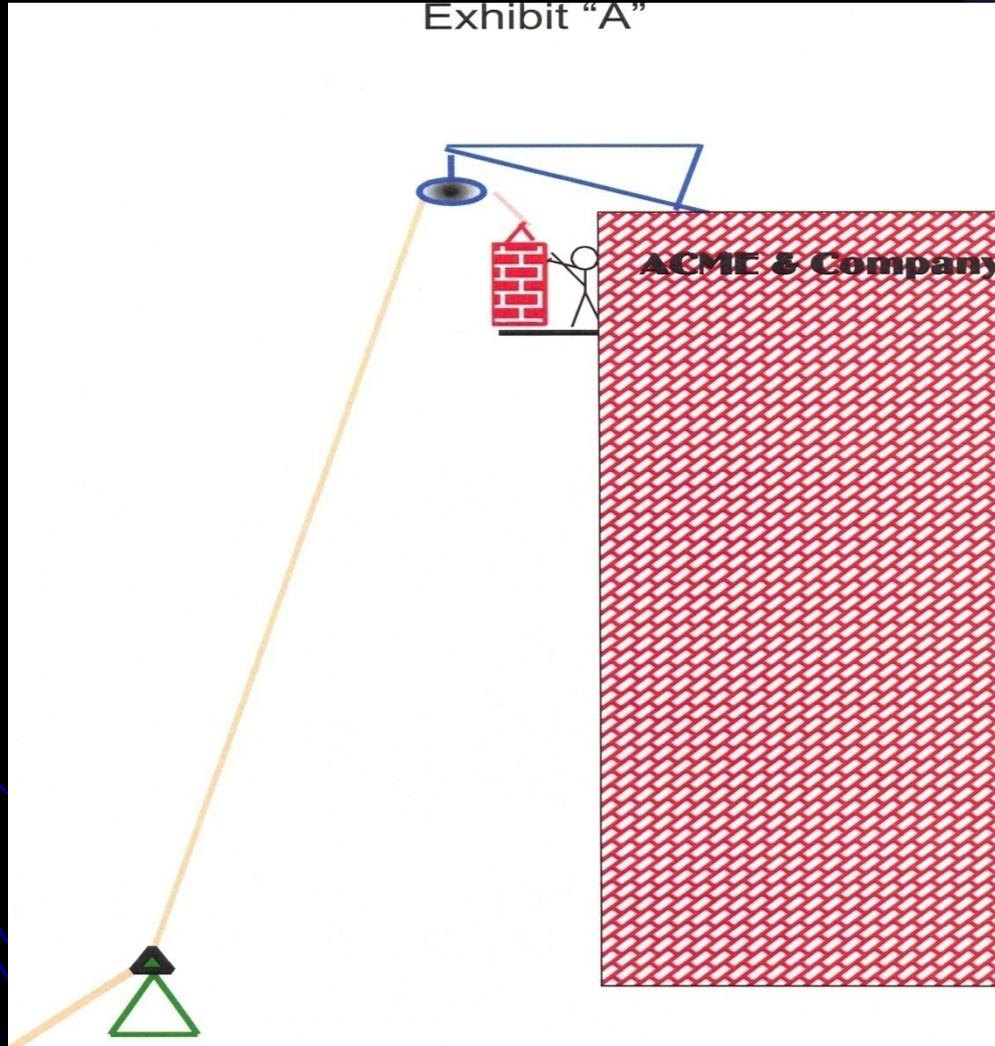
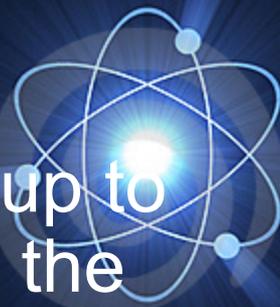


Exhibit "A"





Securing the rope at ground level, I went up to the roof, swung the barrel out and loaded the bricks into it.

Then I went down and untied the rope, holding it tightly to insure a slow descent of the 240 lbs of bricks.

You will note that on the accident report form that my weight is 185 lbs.

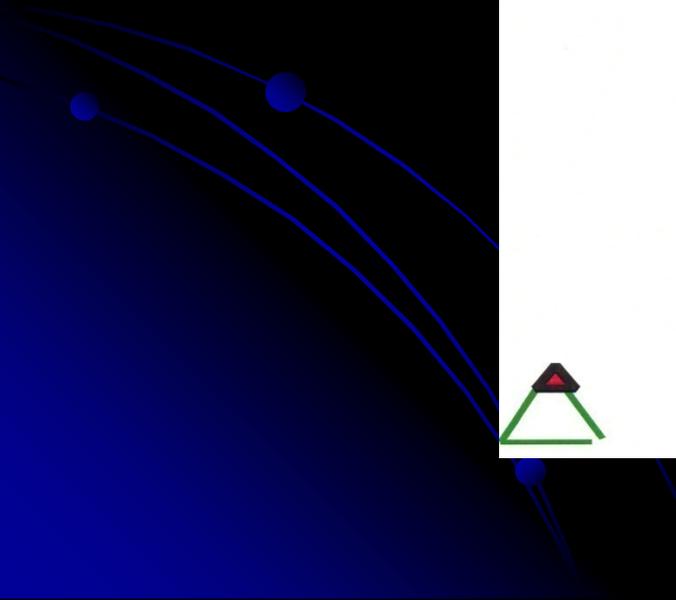
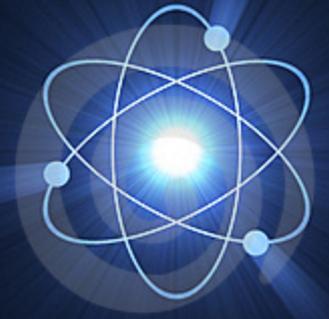
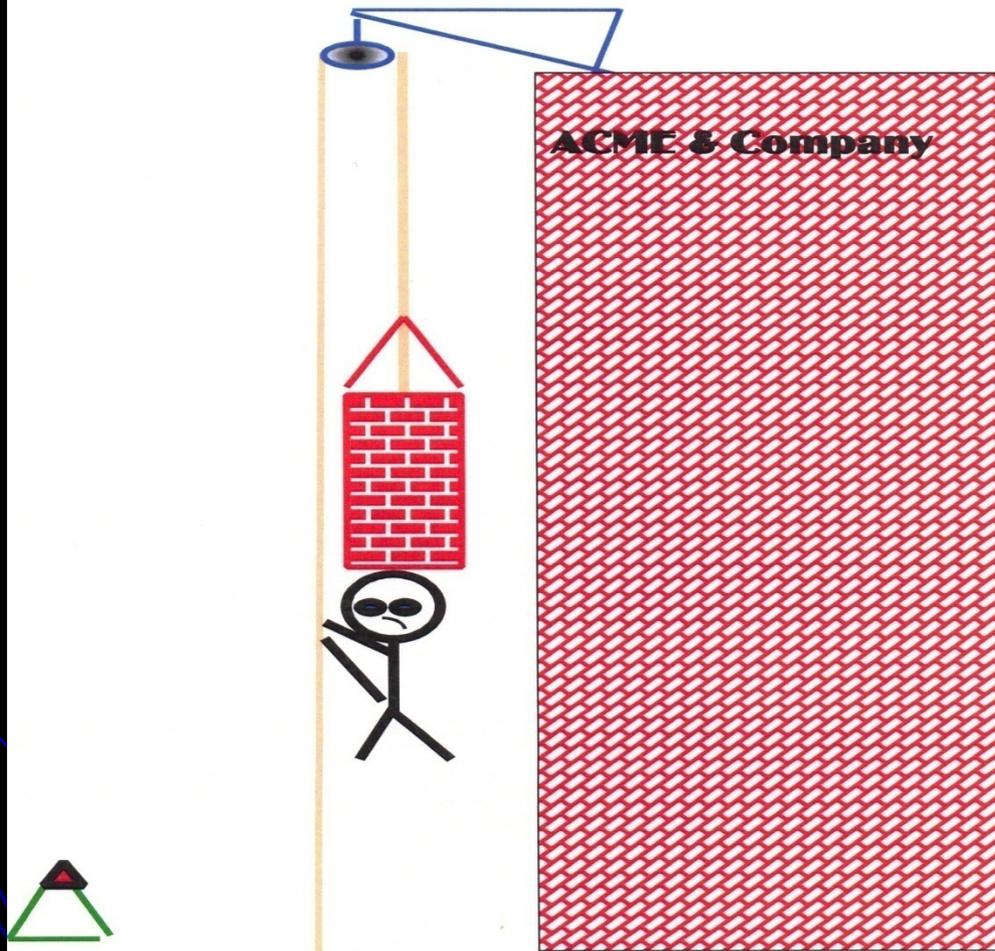


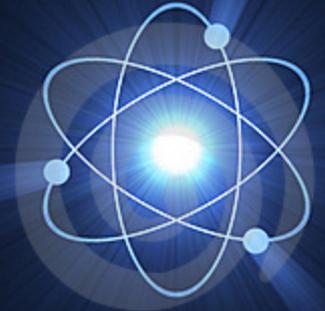
Due to my surprise at being jerked off the ground so suddenly, I lost my presence of mind and forgot to let go of the rope.

Needless to say, I proceeded at a rapid rate up the side of the building.

In the vicinity of the third floor, I met the barrel which was now proceeding downward at an equally impressive speed ( see exhibit "B").

Exhibit "B"

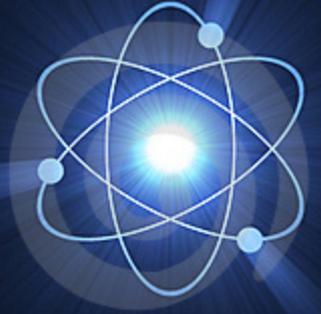
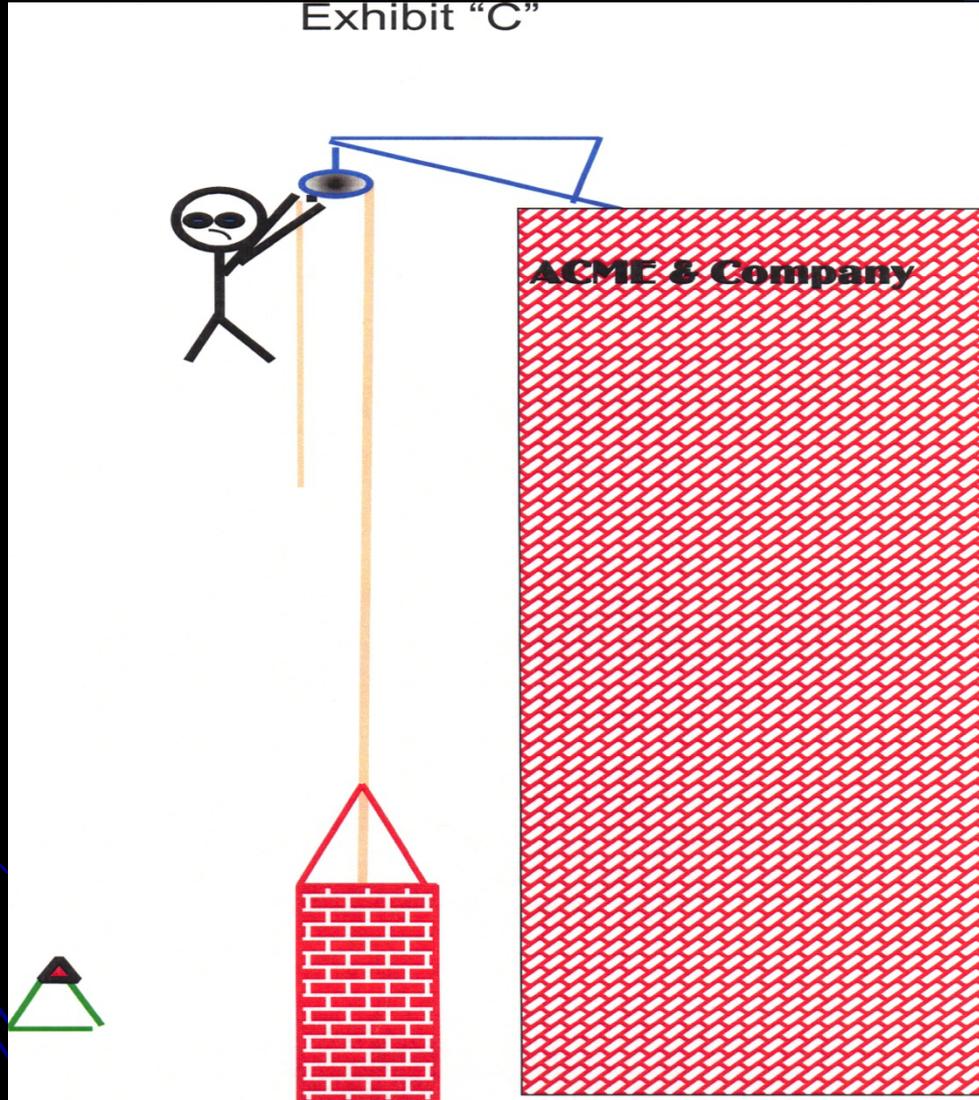




This explains the fractured skull, minor abrasions and the broken collarbone, as listed in section 3 on the accident reporting form.

Slowed only slightly, I continued my rapid ascent, not stopping until the fingers of my right hand were two knuckles deep into the pulley as noted in paragraph 2 (see exhibit "C").

Exhibit "C"

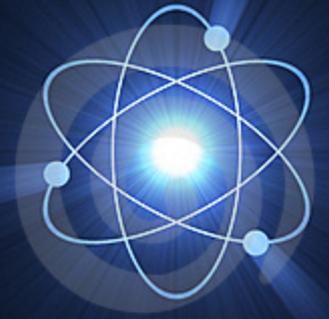
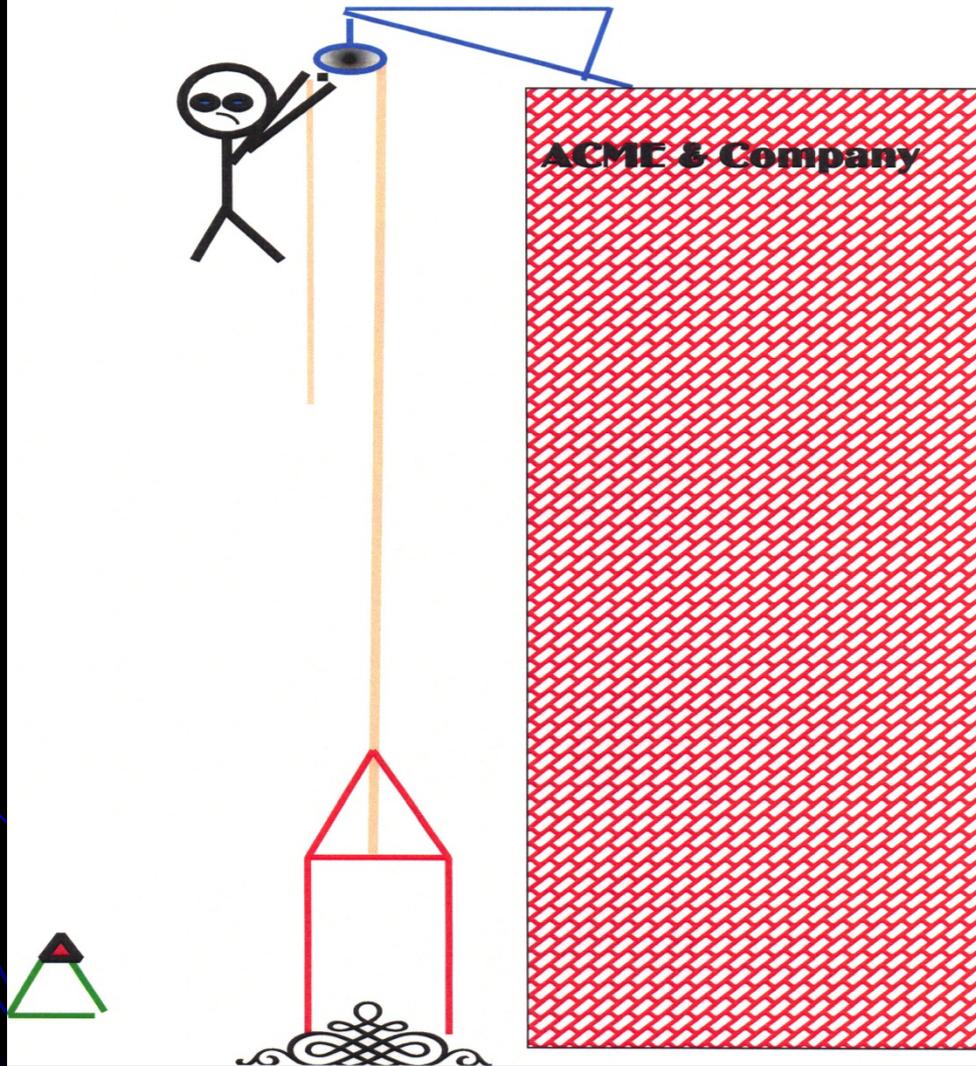


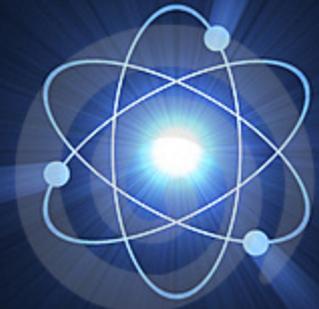


Fortunately by this time I had regained my presence of mind and was able to hold tightly to the rope, in spite of the excruciating pain I was now beginning to experience.

- At approximately the same time, however, the barrel of bricks hit the ground - and the bottom fell out of the barrel (see exhibit "D").

Exhibit "D"



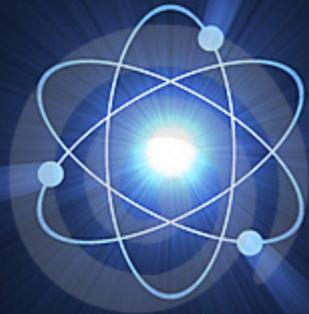
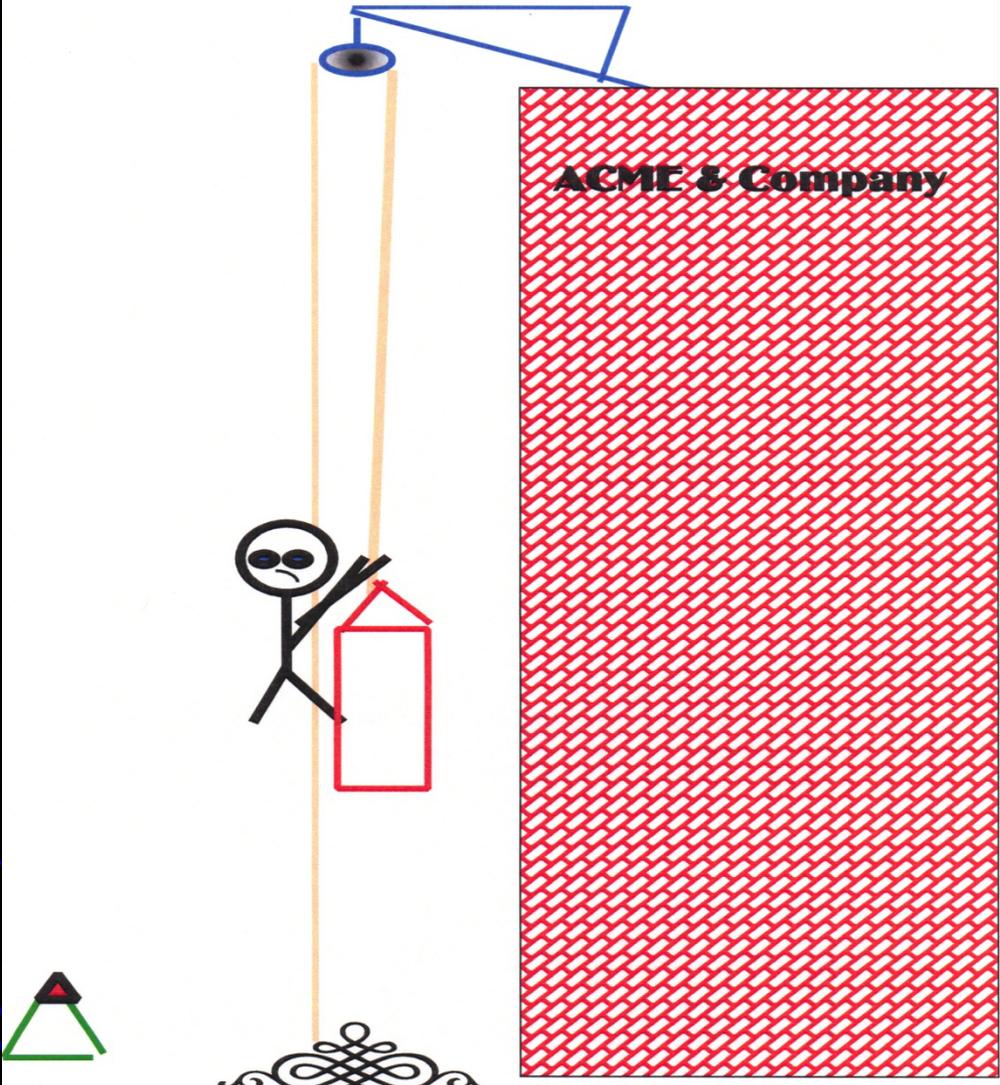


Now devoid of the weight of the bricks, the barrel weighed approximately 50 lbs.

I refer you again to my weight. As you might imagine, j began a rapid descent down the side of the building.

Again, in the vicinity of the third floor, I met the barrel coming up (see exhibit "E").

Exhibit "E"



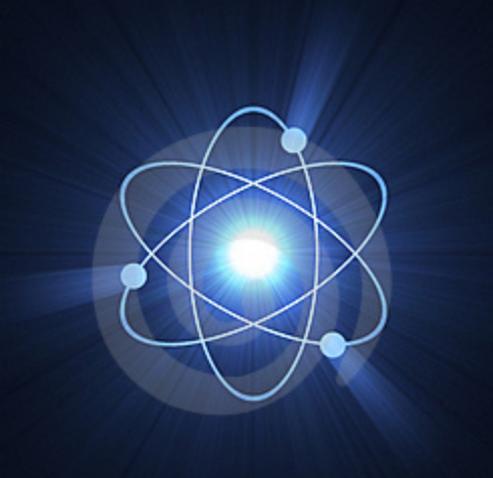
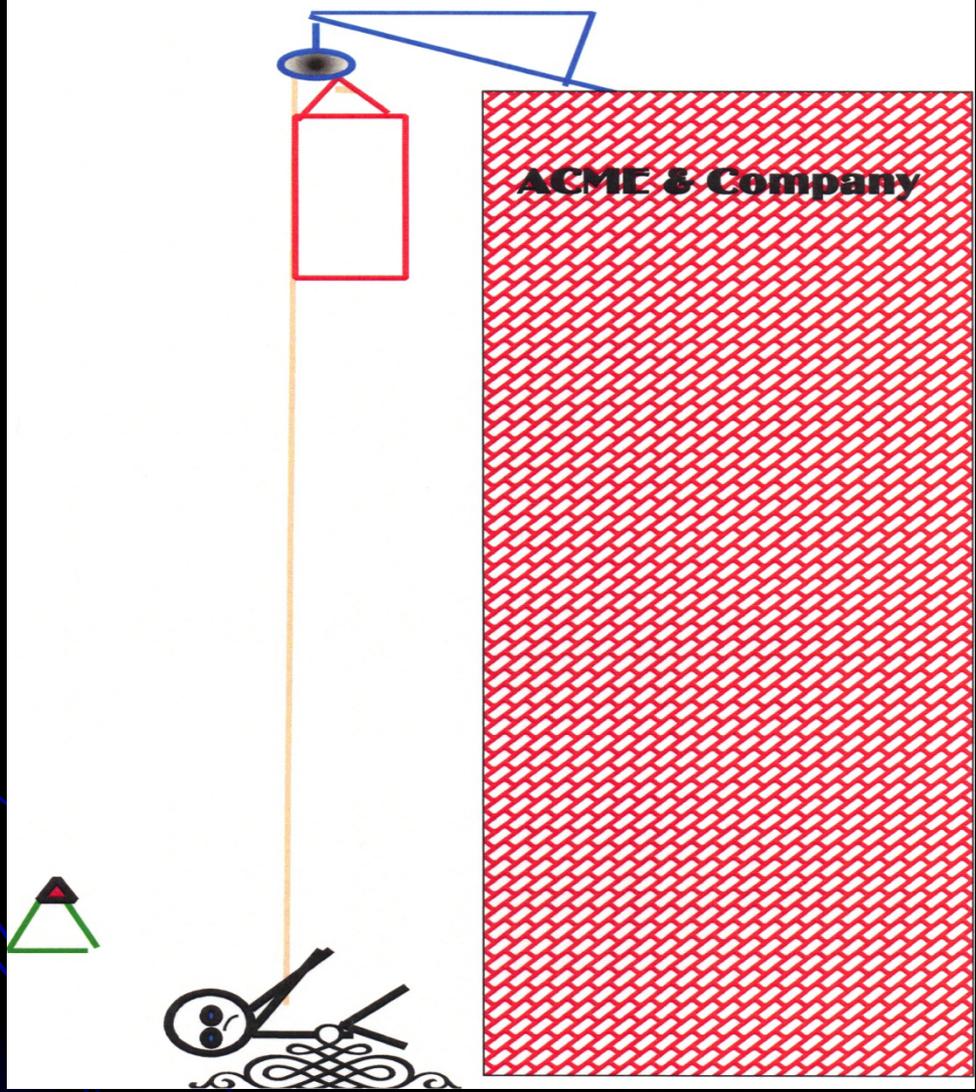


This accounts for the two fractured ankles, broken tooth and severe lacerations of my legs and lower body.

Here my luck began to change slightly.

The encounter with the barrel seemed to slow my descent which lessened my injuries when I fell on the pile of bricks (see exhibit "F").

Exhibit "F"



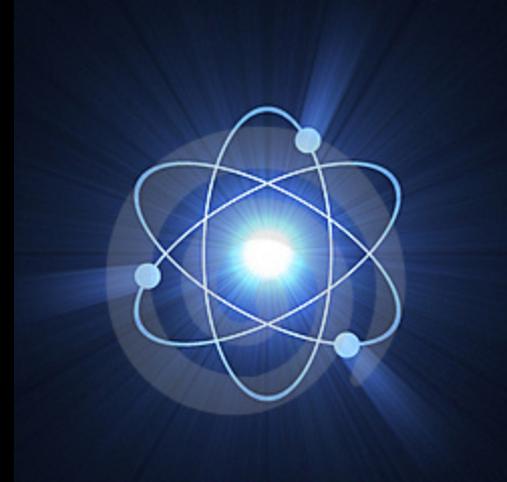
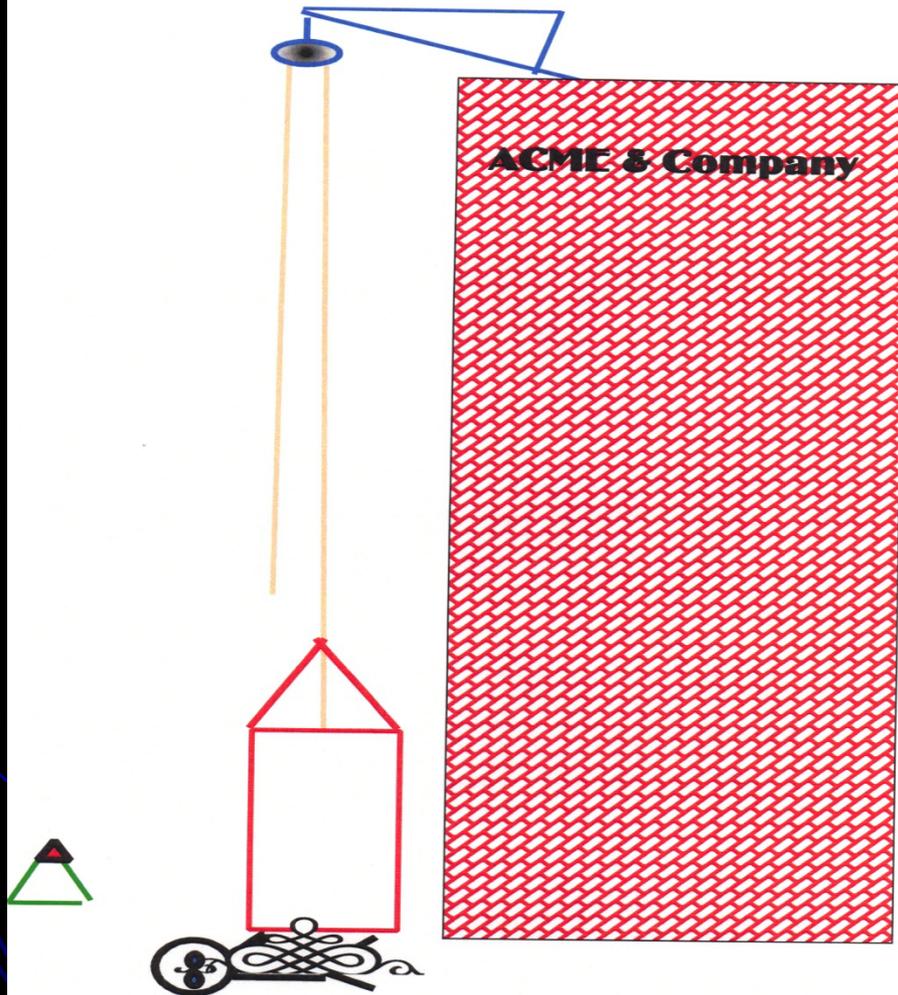


Fortunately only three vertebrae were cracked.

I am sorry to report, however, as I lay there on the pile of bricks, in pain, unable to move and watching the empty barrel six stories above me, I again lost my composure and presence of mind and let go of the rope.

I laid there helplessly watching the empty barrel begin its journey back onto me (see exhibit "G").

Exhibit "G"

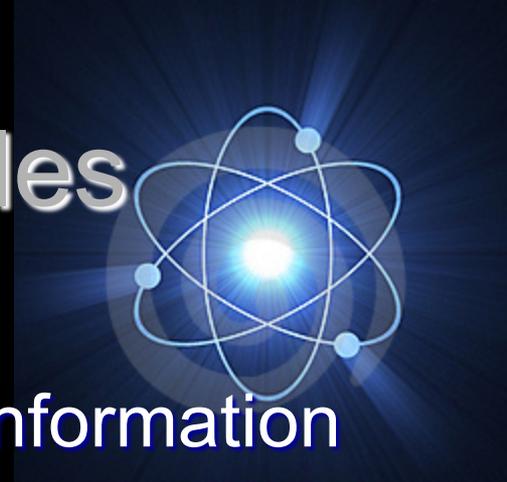


# Plausibility vs. Implausibility



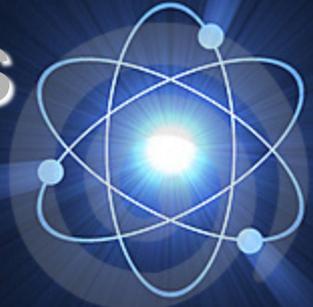
- **Plausible:** reasonable, appearing worthy of belief (seemingly true, appears to be reasonable or valid)
- **Implausible:** provoking disbelief

# Distractor Plausibility Rules of the Road



- The distractor must NOT conflict with information in the stem
- The distractor must NOT be a subset of another distractor or the answer
- The distractor must be consistent with the laws of physics

# Distractor Plausibility Rules of the Road



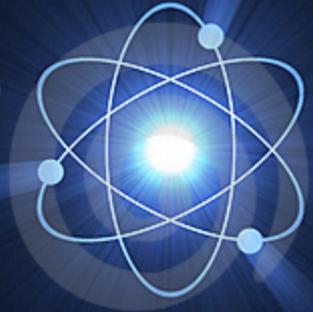
- The plant process referred to by the distractor must exist at the plant
- The equipment configuration or flow path must be physically possible
- The switch position referenced by the distractor must exist on the component or on a similar component

# Distractor Plausibility Rules of the Road



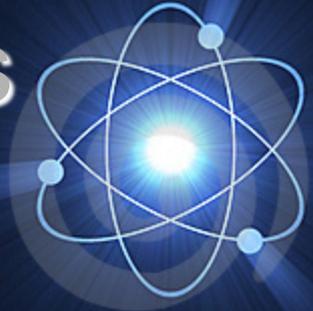
- The component (e.g. power supply) in the distractor must be in the same category (e.g. safety related) as the answer
- A system used as a distractor must operate in a similar manner as other systems (*Who's ever heard of an AC emergency bearing oil pump?*)
- The value in a distractor should correspond to an equipment set point (e.g. alarm set point)

# Distractor Plausibility Rules of the Road



- The value referenced in a distractor should correspond to an incorrect method of calculation (e.g. using the wrong curve, using psig vs. psia)
- The terminology (e.g. job title, action) must be used at the plant
- The action referenced in the distractor must occur in the procedure or in a similar procedure

# Distractor Plausibility Rules of the Road



- The distractor should become the correct answer if the procedure was not implemented correctly
- The distractor could become the correct answer if an outdated equipment modification or procedure revision (i.e., within the last couple of cycles) was used instead of the current configuration or revision



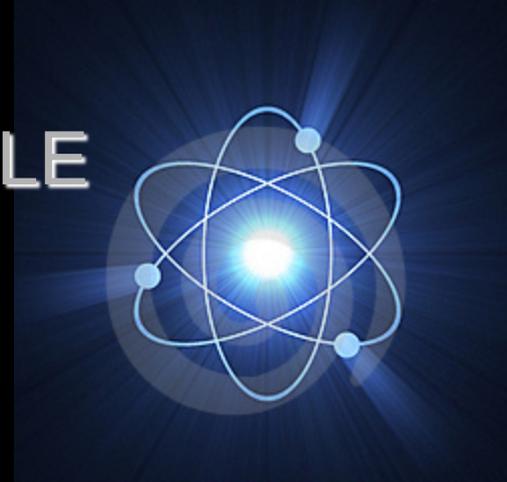
# Distractor Plausibility Rules of the Road



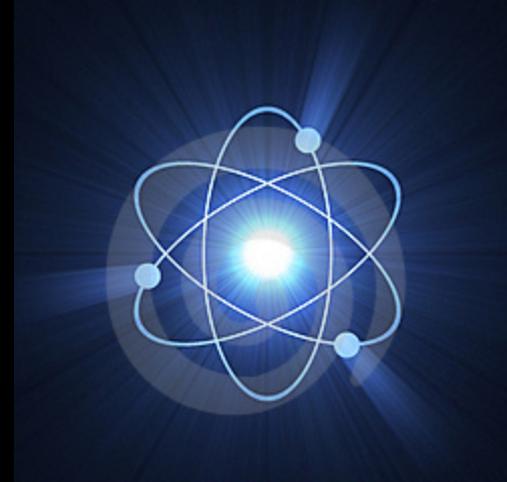
- A minor change in the stem (e.g. containment pressure = adverse value) will make the distractor correct
- Both distractor elements in a '2x2' question must have an LOD of greater than or equal to 2

# EXAMPLES OF IMPLAUSIBLE DISTRACTORS

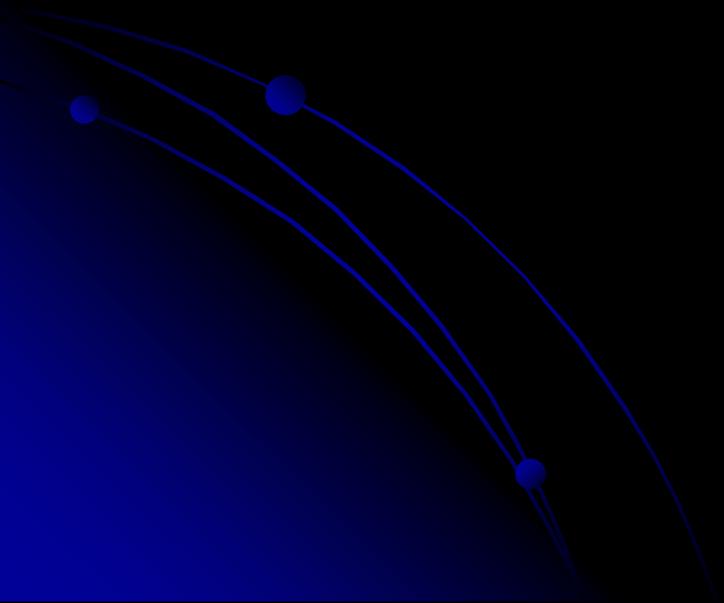
Seven (7) categories



- **Requires Minimal Plant Knowledge (Majority)**
- **Fails Common Sense Test**
- **“Double Distractors” [ 1 of 2 Taken Twice ] With 2 Distractors Having LOD = 1**
- **Physics Not Correct**
- **Distractors Conflict With Information In Question Stem**
- **Distractors Not Independent From Each Other**
- **Use of a Distractor About a Plant Process That Does Not Exist**



The following are examples of bad questions



# “Double Distractors” [1 of 2 Taken Twice] With 2 Distractors Having LOD = 1



Given the following plant conditions:

- Reactor power is 100%
- Pressurizer pressure channel I, 429, has been removed from service for surveillance testing with its' associated bistables tripped
- **Pressurizer pressure channel IV, 449, fails LOW**

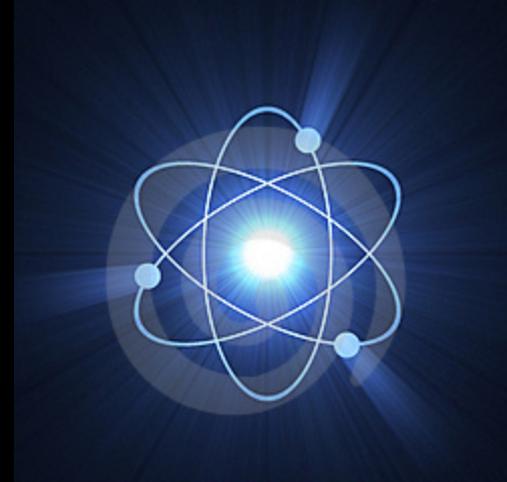
Which ONE of the following describes the result of these conditions?

- A. Reactor trip, but NO Safety Injection  
Pzr PORV PR-2A remains closed
- B. Reactor trip and Safety Injection  
Pzr PORV PR-2A remains closed
- C. Reactor trip but NO Safety Injection  
**Pzr PORV PR-2A opens**
- D. Reactor trip and Safety Injectio  
**Pzr PORV PR-2A opens**

## NRC Comment:

Distractors C and D are not plausible, since **there is no reason for a Pzr PORV to open on a low Pzr pressure signal.**

# Physics Not Correct



Torus water temperature rises from 75 ° F to 95 ° F over several weeks due to summer heat.

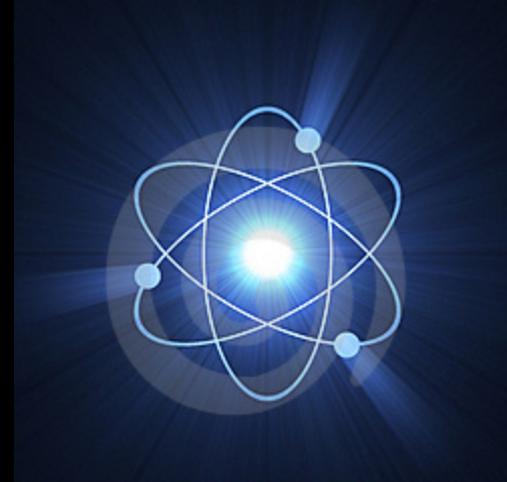
Which of the following **describes the effect of the rise in torus water temperature?**

- A. **The INCREASE in torus airspace** would result in LOWER post-LOCA peak drywell pressure.
- B. **The DECREASE in torus water level** would result in LOWER available NPSH for the ECCS pumps.
- C. The DECREASE in torus airspace would result in HIGHER post-LOCA peak drywell pressure.
- D. The INCREASE in torus water level would result in HIGHER available NPSH for the ECCS pumps.

## NRC Comment:

Distractors A and B are not plausible that **an increase in torus water temperature would NOT cause a decrease in torus water level or an increase in torus airspace** (since almost everyone knows that water expands when heated over this temperature range).

# Fails Common Sense Test



Given the following conditions:

- Fuel handling is in progress in Containment and the Spent Fuel Pool (SFP).
- Radiation Monitor R-5 SPENT FUEL POOL AREA MONITOR **fails LOW**
- All other radiation monitors are operable.

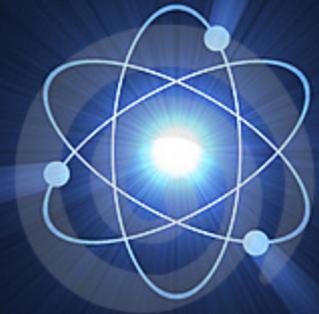
What is the impact of this failure?

- A. Fuel handling in the SFP and Containment must be stopped.
- B. Fuel handling in the SFP ONLY must be stopped.
- C. The SFP must be evacuated.**
- D. None provided R-28 NEW FUEL PIT AREA CRITICALITY MONITOR is operable.

NRC Comment:

**Distractor C is not plausible to require a SFP evacuation on a failed low radiation monitor.**

# Requires Minimal Plant Knowledge



## Given the following conditions:

- Condenser pit flooding on Unit 1 caused an automatic turbine/reactor trip.
- Safety Injection actuated due to a small break LOCA.
- Bus 11 is deenergized.
- **RCS pressure is stable at 1725 psig.**
- RCS temperature is 370F.
- 11 SG level is 13% NR and rising.
- 12 SG level is 48% NR and stable.
- AFW flow is 50 gpm to 11 SG only.
- 1ES-1.1 "Post-LOCA Cooldown and Depressurization" is in progress.

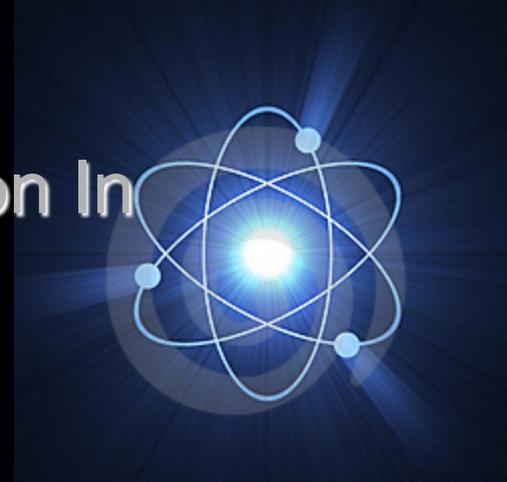
## What method for cooldown should be selected?

- A. Dump steam to the condenser from both SGs.
- B. Dump steam to the condenser from 12 SG only.
- C. Place RHR in service per SOI-4, "Residual Heat Removal System."**
- D. Dump steam from both SG PORVs.

### NRC Comment:

**Distractor C is not plausible to place the RHR system in service with RCS pressure at 1725 psig.**

# Distractors Conflict With Information In Question Stem



The plant is operating at 100% power.

A failure of the governor/pressure regulator occurs **which causes the turbine control valves to fully open.**

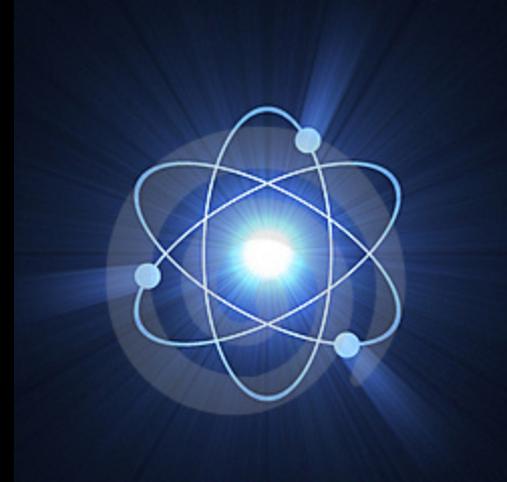
Which one of the following RPS functions will scram the reactor?

- A. Main Steam Isolation Valve Closure
- B. APRM flux - Upscale
- C. Low RPV water level
- D. Turbine Control Valve Closure**

**NRC Comment:**

**Distractor D is not plausible since the question stem states that the turbine control valves have failed open.**

# Distractors Not Independent From Each other



A fully qualified Radiation Worker was escorting a male visitor with no previous exposure through the Reactor Building when they inadvertently walked through a High radiation area.

Assuming no previous exposure, RP personnel read the dosimeters for the individuals and calculated that they received the following radiation exposure:

- Chest 800 mrem
- Hands 1060 mrem
- Eye Lens 510 mrem
- Internal 550 mrem

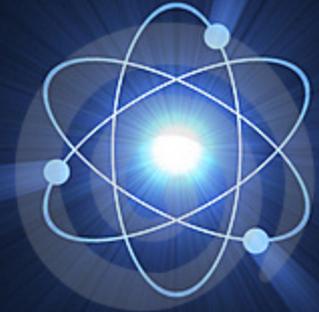
Which, if any, exposure limit has been exceeded?

- A. **Both exceeded Federal TEDE limits.**
- B. Both exceeded administrative TEDE limits.
- C. The male visitor exceeded the federal TEDE limit.
- D. **The fully qualified Radiation Worker exceeded the federal TEDE limit.**

**NRC Comment:**

**Distractor D is not plausible because it is a subset of distractor A (i.e., if distractor A were correct, then distractor D would also be correct).**

# Use of a Distractor About a Plant Process That Does Not Exist



IMD is about to commence a surveillance test, with the following:

- The surveillance test will cause a TECH SPEC-REQUIRED plant instrument to be INOPERABLE for the duration of the test
- Performance of the surveillance test does NOT require an LCO ACTION entry

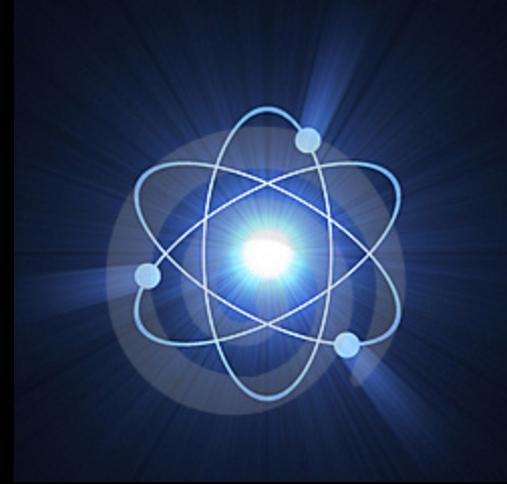
Which ONE of the following describes a CRS required action, PRIOR to IMD beginning the surveillance test?

- A. **Direct the RO to hang an Adverse Condition Monitoring Tag** on the annunciator window associated with the instrument.
- B. Direct IMD to hang an Equipment Status Tag (EST) on the instrument, and the RO to hang a Miniature EST in the Control Room.
- C. Identify the Technical Specification required action in the event the instrument is still INOPERABLE when the Short Duration Time Clock (SDTC) expires.
- D. Identify the Maximum Out of Service Time (MOST) for the instrument and direct IMD to notify the control room if the test is still in progress within 30 minutes of the MOST.

## NRC Comment:

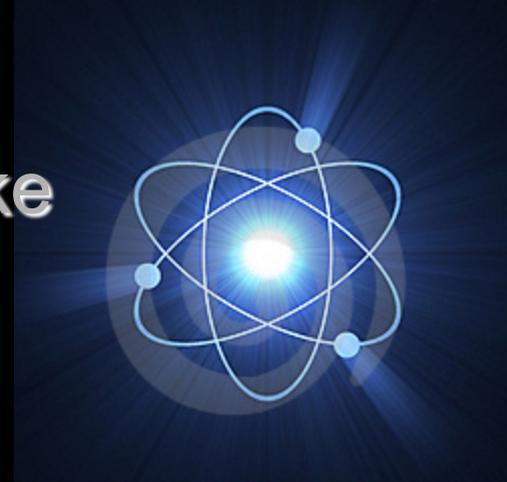
Distractor A is not plausible to direct hanging an **Adverse Condition Monitoring Tag** (i.e., a tag that does not exist). Suggest changing distractor A to “Initiate a Degraded Equipment Log (DEL) entry for the instrument.”

# Techniques to Make Distractors more plausible



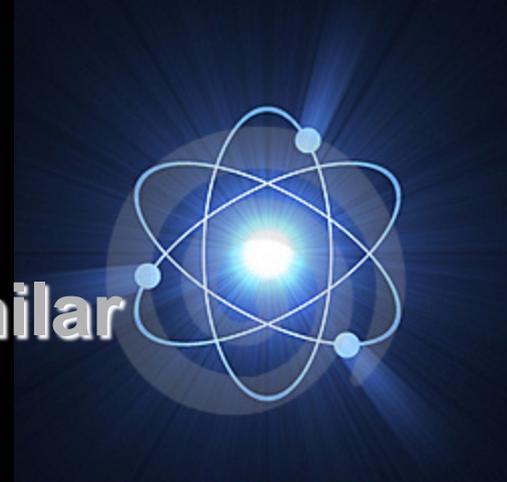
- Include common misconceptions
- Make distractors relatively similar

What are some techniques to make distractors more plausible?

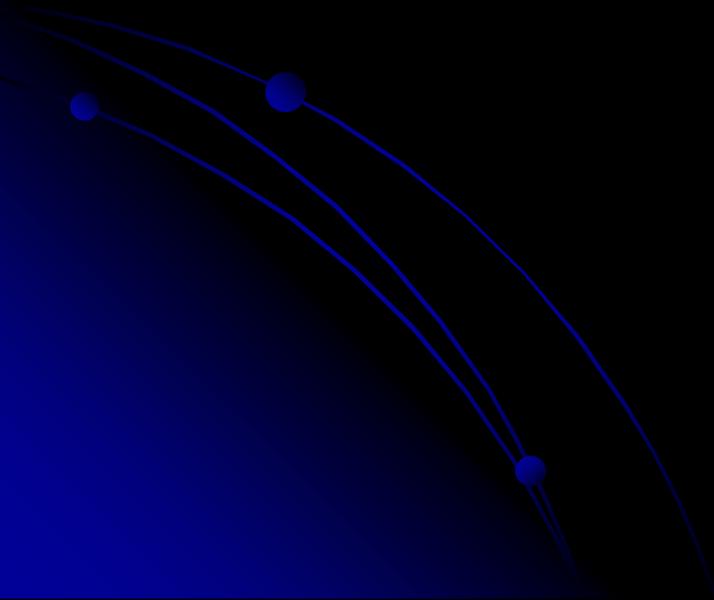


- **Include common misconceptions**
  - **Different solutions while using a mollier diagram**
  - **If they zigged when they should have zagged, then have an answer for them**

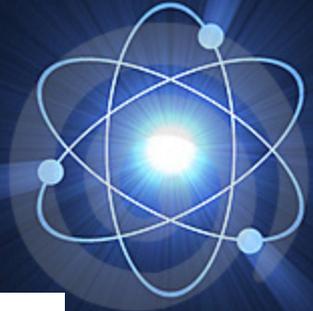
**Make distractors relatively similar**



- **2 out of 4 taken twice**



# Example 1



Given the following conditions on Unit 1:

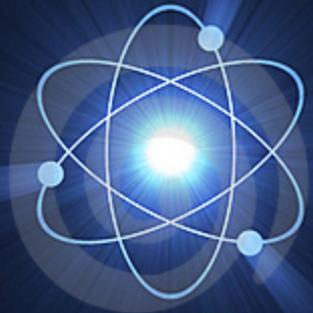
- Unit is operating at 100% RTP
- The controller for 1KC-132 (Letdown Hx Outlet Temp Ctrl) has been placed in MANUAL due to erratic operation
- Subsequently, NV letdown flow is increased by 10 GPM as requested by Chemistry

As letdown temperature increases, NC system boron concentration will  (1)   AND  if letdown temperature continues to increase, letdown flow will automatically bypass the demineralizer at  (2) .

Which ONE (1) of the following completes the statement above?

- A. 1. INCREASE  
2. 120°F
- B. 1. INCREASE  
2. 138°F
- C. 1. DECREASE  
2. 120°F
- D. 1. DECREASE  
2. 138°F

# Level of Detail



## General Discussion

Requires operator to determine the effect of increasing letdown temp on the MB Demineralizer. At low temperatures, the boron affinity is increased. At high temperatures, boron affinity is reduced. If the temperature is increased previously captured boron ions are released from the MB Demineralizer thus increasing NC system boron concentration. If Letdown Hx outlet temperature increases to 138°F, 1NV-127A will divert to the VCT to protect the demineralizer resin.

## Answer A Discussion

INCORRECT: See explanation above.

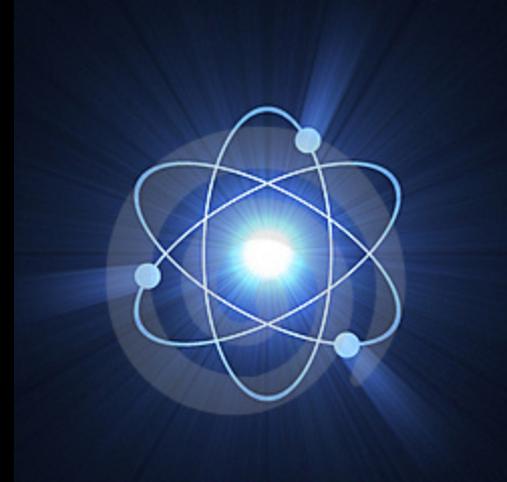
PLAUSIBLE: Answer 1 is correct.

Answer 2 is plausible because the Letdown Hx Outlet Hi Temperature annunciator (1AD-7 / H2) alarms at 120°F.

## Answer B Discussion

CORRECT: See explanation above.

# Level of Detail



## Answer C Discussion

INCORRECT: See explanation above.

PLAUSIBLE: Answer 1 is plausible if applicant does not understand the effects of increasing letdown temperature on the demineralizer resins affinity for boron atoms. It is plausible for the applicant to conclude that increasing temperature (which would cause the demineralizer resin to expand) would result in a larger surface area in the resin and thus increase the probability of boron absorption.

Answer 2 is plausible because the Letdown Hx Outlet Hi Temperature annunciator (1AD-7 / H2) alarms at 120°F.

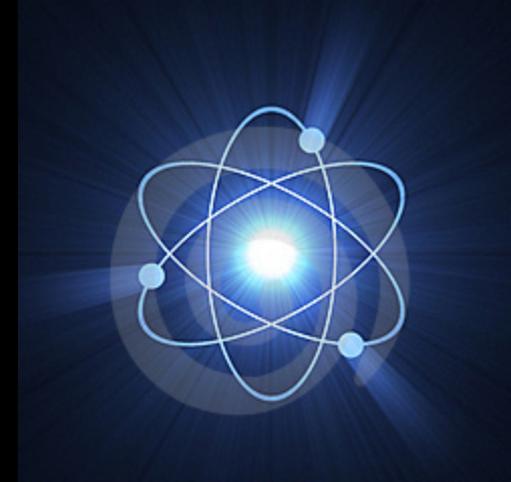
## Answer D Discussion

INCORRECT: See explanation above.

PLAUSIBLE: Answer 1 is plausible if applicant does not understand the effects of increasing letdown temperature on the demineralizer resins affinity for boron atoms. It is plausible for the applicant to conclude that increasing temperature (which would cause the demineralizer resin to expand) would result in a larger surface area in the resin and thus increase the probability of boron absorption.

Answer 2 is correct.

# Level of Detail



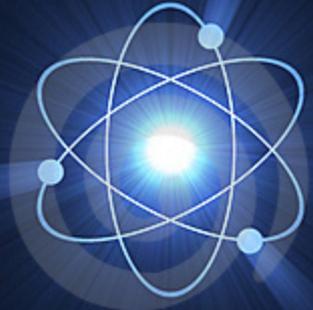
## **Basis for meeting the KA**

The KA is matched because a malfunction has occurred (temperature controller failure) and the applicant must determine how the malfunction affects the "CVCS components" in question (in this case the demineralizers). The applicant must also recall that letdown will be diverted to the VCT on high temperature to protect the demineralizer resin.

## **Basis for Hi Cog**

## **Basis for SRO only**

## Example 2



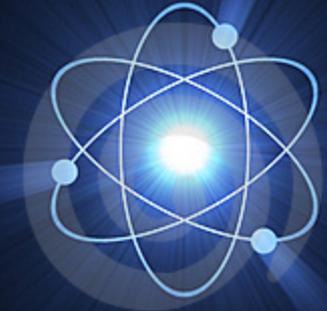
Given the following conditions on Unit 1:

- The unit is operating at 40% RTP
- NCP 'C' trips on overcurrent

Assuming no operator action, which ONE (1) of the following describes the effect on the Departure from Nucleate Boiling Ratio (DNBR) AND reactor thermal power?

- A. DNBR will INCREASE.  
Reactor power decreases and stabilizes at a new lower thermal power.
- B. DNBR will DECREASE.  
Reactor power decreases and stabilizes at a new lower thermal power.
- C. DNBR will INCREASE.  
Reactor power initially decreases and then returns to 40% thermal power.
- D. DNBR will DECREASE.  
Reactor power initially decreases and then returns to 40% thermal power.

# Level of Detail



## General Discussion

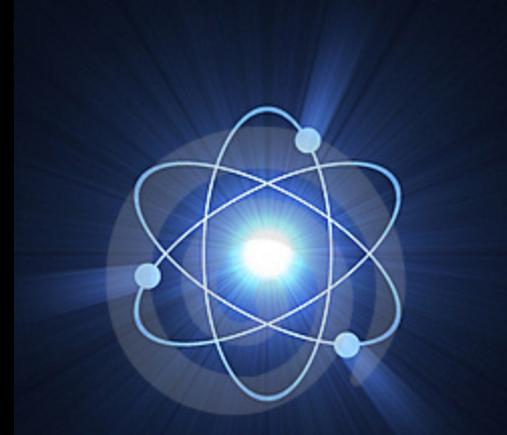
The decrease in Reactor Coolant Flow with reactor power, temperature (core delta-T), and pressure remaining the same will cause a decrease in DNBR. In this case Actual Heat Flux (AHF) remains the same while the Critical Heat Flux (CHF)(amount of heat required to cause a departure from nucleate boiling) will decrease. Therefore DNBR (CHF/AHF) decreases.

Since steam demand has not changed core thermal power ( $Q = mcp\Delta T$ ) must remain the same steady-state to steady-state. However, reactor power will initially decrease due to the immediate effect of the loss of flow (mass flow rate decreases) while core delta-T initially has not changed. After the initial decrease in reactor thermal power, the colder water returning to the reactor will cause an increase in reactor power, core delta-T will increase, and core thermal power will return to 40% thermal power based on steam demand.

The increase in core delta-T will result in the water at the core exit being closer to vaporization and therefore CHF decreases causes an additional decrease in DNBR.

The conclusion is that DNBR decreases and reactor power will initially decrease and then return to 40% thermal power.

# Level of Detail



## Answer A Discussion

INCORRECT: See explanation above.

PLAUSIBLE:

The first part is plausible if the applicant confuses the DNBR with an actual departure from nucleate boiling as the likelihood of an actual departure from nucleate boiling has increased.

Part 2 is plausible if the applicant neglects to consider the long-term effect of the NC pump trip. The reactor power will initially decrease due to the decrease in flow. However, power will not stabilize at the new lower power but will return to 40% thermal power since steam demand has remained constant.

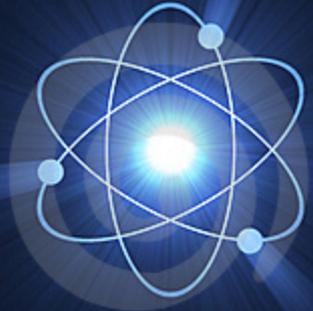
## Answer B Discussion

INCORRECT: See explanation above.

PLAUSIBLE: First part is correct. DNBR does decrease.

Part 2 is plausible if the applicant neglects to consider the long-term effect of the NC pump trip. The reactor power will initially decrease due to the decrease in flow. However, power will not stabilize at the new lower power but will return to 40% thermal power since steam demand has remained constant.

# Level of Detail



## Answer C Discussion

INCORRECT: See explanation above.

PLAUSIBLE:

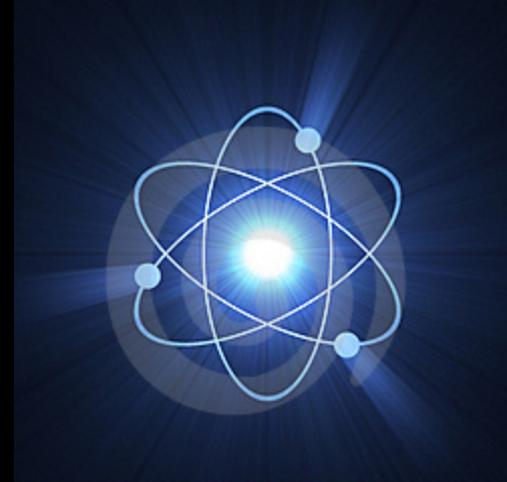
The first part is plausible If the applicant confuses the DNBR with an actual departure from nucleate boiling as the likelihood of an actual departure from nucleate boiling has increased.

The second part of answer is correct.

## Answer D Discussion

CORRECT: See explanation above.

# Level of Detail



## **Basis for meeting the KA**

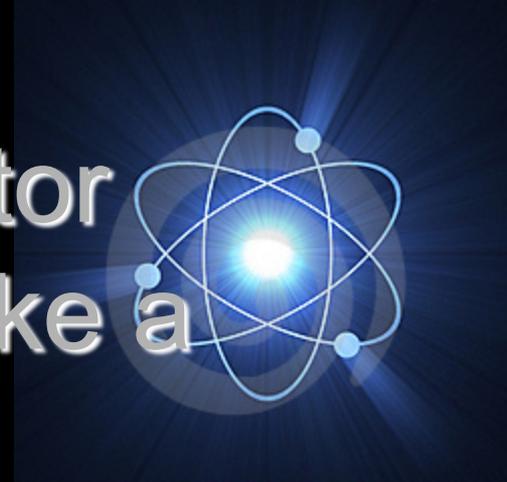
The KA is matched because the applicant must determine the effect of a reduction in NC system flow rate (due to NC pump trip) on core operating parameters (i.e. DNBR & core thermal power).

## **Basis for Hi Cog**

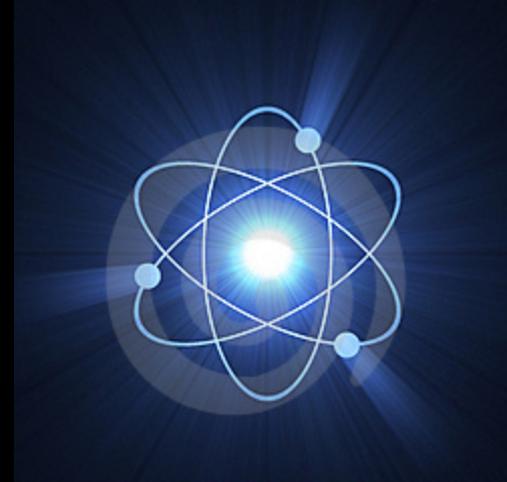
This is a higher cognitive level question because it requires more than one mental step to arrive at the correct answer. The applicant must first determine the effect of the reduction in NC system flow on the DNBR. Then the applicant must determine the long-term effect on reactor thermal power.

## **Basis for SRO only**

# Just remember, Operator Licensing is very much like a Marriage



- It involves 3 rings:
  - An **engagement** ring
    - (getting qualified)
  - A **wedding** ring
    - (writing and administering exams)
  - And **Suffer** ring
    - (having to deal with appeals because of miswritten questions)



# Questions?

