

WHAT IS REQUIRED FOR A SUCCESSFUL TRANSITION FROM DOE TO NRC? MAJOR DISTINCTIONS BETWEEN DOE AND NRC REGULATION

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ABSTRACT

Department Of Energy (DOE) facilities connected with the U. S. military mission were born in a cloak of secrecy amid the paranoia of the late 1940's and 1950's. Communism was on the march worldwide, leading to a rapid expansion of U. S. nuclear weapon production capability. One of the three uranium enrichment plants constructed during this era was the Paducah Plant located in Paducah, Kentucky. The Plant's initial mission was solely the enrichment of uranium to produce nuclear weapons, but by 1960 the government stockpile was full and production focused on the budding commercial nuclear power industry.

Beginning in the late 1970's, there was drastic erosion of the market domination as DOE found itself unable to be price competitive. Fearing the loss of U. S. enrichment capability, Congress, in the late 1980's, began an effort to save this important domestic energy supply and provide for continued national security.

A bill was passed by Congress in 1992 requiring the transition of the two DOE-owned and operated uranium enrichment plants first to a government-owned corporation and then ultimately to full private ownership. It also required that the Nuclear Regulatory Commission (NRC) attempt to provide a nuclear safety "certificate" for the plants and assume regulatory authority from DOE. This certificate process, which paralleled the licensing process for commercial reactors, coincidentally provided a direct comparison between the regulatory approaches of the two agencies.

Based on five years of "before and after" experience in regulatory and business conversions at Paducah, there are 10 "Must Do's" to be successful with a typical DOE to NRC transition. They include:

- Have a rigorous flow-down process for all regulations and commitments into plant procedures
- Set up a Regulatory Affairs Department, a Plant Operations and Review Committee (PORC), and a Employee Concerns function
- Establish configuration control of equipment and records
- Install a strong problem reporting system
- Use scientific root-cause analyses to assure corrective actions are effective
- Foster a universal practice of "follow the procedure or stop the job"
- Conduct high-quality compliance and skill training

- Implement and utilize modern work control practices with great emphasis on safety
- Embed Conduct of Operations in the entire plant

These major “Must Do’s” are truly essential for survival. Paducah demonstrated that a large DOE facility could successfully become NRC regulated and at the same time greatly improve market viability. Major pervasive changes involving the entire workforce had to be implemented in addition to significant upgrade in Plant management processes. It was difficult and it was not free. The cost to convert the Paducah Uranium Enrichment Plant from DOE to NRC regulation eventually exceed 100 million dollars.

WHAT IS REQUIRED FOR A SUCCESSFUL TRANSITION FROM DOE TO NRC? MAJOR DISTINCTIONS BETWEEN DOE AND NRC REGULATION

Department of Energy (DOE) facilities connected with the U. S. military mission were born in a cloak of secrecy amid the paranoia of the late 1940’s and 1950’s. Communism was on the march worldwide, leading to a rapid expansion of U. S. nuclear weapon production capability. One of the three uranium enrichment plants constructed during this era was the Paducah Plant located in Paducah, Kentucky. The plant’s initial mission was solely the enrichment of uranium to produce nuclear weapons. Interestingly, some of the criteria used by DOE’s predecessor, the Atomic Energy Commission (AEC), to site the Paducah Plant included a location more than 6,000 miles from a Soviet airbase; 100 miles from a coast accessible by submarine; and more than 100 miles from the nearest city with known communist subversive activity!

DOE’s enrichment facilities ceased production of weapons material in the 1960’s. The Paducah Plant, along with its two sister plants, concentrated instead on producing nuclear “fuel grade” uranium to supply the budding commercial nuclear power utility business. By 1970, DOE controlled one hundred percent of the enrichment market in the free world. However, beginning in the late 1970’s, there was drastic erosion of this market domination as DOE found itself unable to be price competitive. Fearing the loss of U. S. enrichment capability, Congress, in the late 1980’s, began an effort to save this important domestic energy supply and provide for continued national security. Led by Kentucky’s U. S. Senator Wendell Ford, Congress enacted the associated legislation in 1992 after five failed attempts in the U. S. House of Representatives.

The bill passed in 1992 required the transition of the two DOE-owned and operated uranium enrichment plants first to a government-owned corporation and then ultimately to full private ownership. It also required that the Nuclear Regulatory Commission (NRC) attempt to provide a nuclear safety “certificate” for the plants and assume regulatory authority from DOE. This certificate process, which paralleled the licensing process for commercial reactors, coincidentally provided a direct comparison between the regulatory approaches of the two agencies.

It is not hard to imagine that nuclear safety was not the first-priority DOE objective during the cold war. There was little scrutiny or accountability for safety from outside the facility fences for the first 40 years of existence. Even in the mid-80s, when DOE began to increase emphasis on nuclear safety, it was faced with the extremely difficult task of self-regulation. It is reasonable to assume that no government agency can be successfully held responsible for independent regulation of safety and meeting production at the same time! In 1993, DOE received perhaps its first true comparison of where it stood relative to excellence in nuclear safety when the Energy Policy Act was passed into law in late 1992 to privatize the two

remaining uranium enrichment plants and bring the Nuclear Regulatory Commission (NRC) into the picture.

The Paducah experience, after a three-year transition and one year of operation under an NRC Certificate, has proven that a large DOE facility can successfully be regulated under NRC and can, at the same time, improve market viability. However, the transition process has led to major change, not only in regulatory documentation, but also in operational philosophy and implementation in the field. Major pervasive changes involving the entire workforce had to be implemented in addition to significant upgrades in plant management systems to support this new standard of excellence. It was difficult and it was not free.

Based on five years of “before and after” experience in regulatory and business conversion, there are five key distinctions to be made in philosophy taken by NRC and DOE in their approaches to regulating nuclear safety. All understanding of these distinctions is essential in assisting in the transition process and avoiding significant frustrations and failures in implementing programs as the certification process is pursued. Without an understanding of these distinctions, there may be a naïve assumption that the existing DOE programs can be “spruced up some” and will be acceptable for NRC regulation. This is simply not the case. Much of the time and money involved in the transition process can be attributed to the major plant upgrades required to address these distinctions. The fundamental philosophy differences can be quickly summarized as the following statements:

- NRC holds management fully accountable for safe operation, including total senior management involvement in conservative decisions on safety
- NRC puts great emphasis on self-assessment and avoiding repeat problems
- NRC utilizes tough enforcement for anything less than full compliance with the certification basis, its’ Technical Specifications, and Plant procedures
- NRC places heavy reliance on engineering evaluations of operational safety issues and the routine involvement of engineering in problem resolution
- NRC expects continuous improvement toward a rising standard of excellence

These distinctions are applicable to most DOE facilities which face such a transition and can effectively be used as a framework to chart the path for the transition program. Why these distinctions exist are discussed below:

Why the Basic Distinctions Between NRC and DOE?

NRC holds management fully accountable for safe operations: Under DOE, it has been commonplace to withhold payment from a contractor who has a safety violation. More recently, there have been additional penalties established to allow fines for non-conformance to DOE rules and, with the increased public scrutiny of DOE regulated facilities, DOE has, in the 1990’s, begun to shut-down facilities for safety performance reasons. Because virtually all DOE operations are government-owned and contractor-operated, shutdown may not be a significant financial impact on a company’s bottomline or stock value. Contractors typically have little investment at stake and the financial impact is limited to reduced fee payment. In most cases, unless substantial outside pressure is brought to bear on a DOE facility such as a major public outcry, there are few replacements of top level managers.

Under NRC, the facility is usually privately-owned and, when the operations is significantly limited or stopped for safety reasons, the lost return on investment is so severe that a company

will often quickly move to replace top management. Additionally, NRC uses substantial civil penalties and the media to heighten the embarrassment to corporations for safety violations by prompt and full disclosure of management failures. This clear accountability for the safety and performance of a facility brings a personal management interest and dedication to avoiding safety problems.

NRC puts great emphasis on self-assessment and avoiding repeat problems: Credit is given by NRC to certificate holders for self-discovery of problems. NRC typically allows a plant's management team to self-identify issues and "fix it once" through effective and prompt corrective actions with little interference when effective self-assessment is demonstrated. For credit to be given, these problems must be identified through self-assessment efforts that cannot be "self-revealing" or repeat problem. If they are repeat problems, or they are problems discovered by the NRC inspectors, NRC does not take a "hands off" approach. Escalated enforcement and civil penalties can follow quickly.

Under DOE, self-assessment was not emphasized as much as it is with NRC because self-assessment is driven in part by a strong dedication to continuous improvement and continuous improvement is not an ongoing priority in DOE! For example, in response to plant violations, DOE did not consistently give credit for self-identification and most corrective actions tended to be more prescriptive. This resulted in inadequate incentive for DOE facilities to self-assess and made it harder for DOE to hold facilities accountable for the effectiveness of corrective actions given that DOE may have influenced the actions taken to fix the problem.

NRC utilizes tough enforcement for anything less than full compliance with the certification basis, its' technical specifications and plant procedures: NRC takes escalated enforcement action, including stiff fines and penalties, for violations of technical specifications or other commitments. The harshest NRC actions are a result of repeat violations. Under DOE, compliance is a target, but is not always rigorously enforced. Typically, DOE facilities are somewhere between 50 – 80 percent compliant with DOE Orders which number in the hundreds. Although DOE contractors approach compliance in the operation of the facilities through action plans and schedules, some deviations are tolerated, and corrective actions may go unfunded. Whether it is a technical specification or a safety related plant procedure, NRC requires verbatim compliance. Failure to do so can bring severe regulator response particularly when there are patterns or repeat violations.

NRC places a heavy reliance on engineering evaluation of day-to-day safety issues: DOE and NRC use a similar approach in determining the safety "authorization basis" and "certification basis," respectively. Both of these so-called "safety basis" rely heavily on engineering to analyze credible accident scenarios that state the maximum likely health, safety, and environmental impacts on the public and the worker. As part of the above, engineering also helps develop countermeasures to assure the maximum impacts referred to as design basis accidents are never reached or exceeded. These countermeasures are varied and usually take the form of engineered safety systems and administrative controls necessary to protect the public and workers. Both the DOE authorization basis and the NRC certification basis are contained in an engineering document called a Safety Analysis Report (SAR). From there, technical specifications (tech specs) are developed to identify key requirements that must be followed by operators at the plants so that the SAR is not violated. DOE has Operational Safety Requirement (OSRs) and NRC uses Technical Safety Requirements (TSRs) that are their tech specs. Up to this point, the DOE and NRC use of engineering is a lot alike with a bit more reliance by DOE

on hazard screening to do accident analyses vs NRC's probabilistic approach and also more reliance by NRC on traceable nuclear industry codes and standards. However, a substantial difference can be seen between DOE and NRC for ongoing use of engineering in the more routine evaluations of operating conditions to assess potential deviations once the SAR is in place. NRC has more rigorous expectations for a technical basis for all operational safety-related decisions. The heavier reliance by NRC on analytic approaches to safety deviations is made possible in part by certificate holders commitment to traceable nuclear industry codes and standards.

When questionable conditions are identified in an operating plant, engineering has very strict and specific analysis and reporting steps that must be adhered to at all times. When an error or potential safety concern is recognized such as safety stem problem or operator deviation, rigorous analysis called a safety evaluation must be performed to help convince the NRC that a definitive condition referred to as "operability" exists or if the system is "inoperable" due to degraded functionality. The results of these engineering efforts play the major role in determining the level of NRC's response to certificate holder failures. DOE, on the other hand, tends to be more flexible in accepting a reasonable solution. Under DOE regulation, there is definitely less reliance on day-to-day engineering evaluations which can result in more subjective decisions.

NRC expects continuous improvement toward a rising standard: NRC expects the certificate holder to constantly improve in order to increase safety margin. This expectation is focused beyond minimum compliance. NRC knows that performance varies and that an operation just on the edge of "minimum requirements" will, through normal variations, eventually fall below these requirements. When this happens, events that impact the public and workforce are inevitable. Several NRC regulatory options are used to bring pressure for continuous performance improvement. The "Watch List" and Systematic Assessment of Licensee Performance (SALP) are two of the pressure points typically used in the commercial nuclear power stations to drive continuous improvement. By publicizing plant performance, graded against a set of standards and in comparison with peer nuclear facilities, NRC is a catalyst for constant improvement. The plants are incentivized to achieve SALP 1 or 2 status because of positive publicity, accompanying reduction in NRC inspections, and the general correlation between good SALP performance and production success. Constant improvement is not seen in DOE facilities to the same degree because there is not long-term emphasis by DOE and plant management. For example, contractors may actually feel there are disincentives to improvements that lead to lower costs because, with smaller budgets, DOE award fee may potentially be reduced.

What are the "Must Do's"?

An understanding of these five distinctions in regulatory approaches between NRC and DOE underscores the necessity of specific implementing programs, organizational changes, management systems, etc. in a plant which must undergo the transition from DOE to NRC. Although the "as found" beginning point for each plant may vary somewhat, there are ten "must do's" which were identified in the Paducah experience that need to be present to achieve at least minimum performance. It is a strong belief, based on the Paducah experience, that these are necessary for survival. The ten "must do's" are first summarized in a list and then discussed in detail below. The point being made with this list is not that these things are absent in DOE facilities and present only under NRC. All of these exist to some extent in DOE space and there are instances such as development of the safety analysis report that they may be equivalent. If

DOE facilities were in 100% compliance with DOE Orders, there certainly would be more parity in the rigor of the two regulatory approaches.

- Have a rigorous flowdown process for all regulations and commitments into plant procedures
- Set up a Regulatory Affairs Department, a Plant Operations and Review Committee (PORC), and an Employee Concerns function
- Establish a Nuclear Safety Engineering Department to perform thorough engineering evaluations of routine operational safety issues
- Establish configuration control of equipment and records
- Install a strong problem reporting system
- Use scientific root-cause analyses to assure corrective actions are effective
- Foster a universal practice of “follow the procedure or stop the job”
- Conduct high-quality compliance and skill training
- Implement and utilize modern work control practices with great emphasis on safety
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Have a rigorous flow-down process for all regulations and commitments into Plant Procedures: Because DOE facilities are not in full compliance with all applicable DOE Orders, it is a given that 100% of requirements are not covered in operational procedures. Thus, the process called “flow-down” to capture and embed all requirements in procedures is not as aggressively pursued. On the other hand, failure to fully “flow-down,” and meticulously implement, all NRC requirements will result in violations and/or monetary penalties.

Success depends on meticulous attention to detail in assuring all requirements in the NRC application are completely covered in plant procedures. To do this successfully, there must be a process to first identify individual commitments that have been made to the NRC and assure these commitments are then installed in procedures and properly implemented by plant staff. At Paducah, over 6000 requirements were committed to, flowed-down, and implemented via approved procedures.

Set up a Regulatory Affairs Department, a Plant Operations and Review Committee (PORC), and an Employee Concerns Program: Under NRC, having a Regulatory Affairs group responsible for maintaining the license or certificate is important. Especially in the development of the initial certificate application, it is necessary to maintain a focused line of communication and interpretation. After the certificate is approved, the Regulatory Affairs provides an ongoing communication link to the NRC inspectors and regional office. In addition, it continues to monitor the implementation of the regulatory commitments and plays a vital role in the ongoing configuration control of the certificate requirements. Likewise, the Plant Operations Review Committee (PORC) is necessary under NRC. This committee is chartered to involve senior management in conservative decisions important to safety and provide an ongoing means to analyze changes for impact on safety margins. A major role of the PORC is to provide assurance that the nuclear safety aspects of a modification have been reviewed by senior management and are acceptable. Typically, in a DOE environment, there is less emphasis placed on the safety impacts of a plant modification. An Employee Concerns function is another mandatory presence under NRC. The Employee Concerns Department assures management listens and responds to safety issues raised by workers that may have been ignored by line management. An Employee Concerns Program must guarantee confidentiality to people who have a safety issue but may fear real or perceived management reprisal.

Establish a Nuclear Safety Department for Routine Operations Analyses: As indicated above under the distinctions sections, there is more use of engineering to analyze routine situations that potentially degrade safety conditions under NRC. Because of NRC's reliance on the engineering evaluations to determine the plant safety margins, it is essential to have engineering more involved in daily plant operations. This includes the evaluation of routine operational issues in addition to the "major failure events". In NRC's eyes, this involvement adds a marked measure of technical credibility. In a DOE environment, routine regulator questions are generally directed at the operating organization and do not so much involve engineering. Under DOE, where engineering evaluations were done, they typically were production-oriented, had less rigor, and did not have the details of nuclear safety impact. In an NRC facility this process is reversed and questions are more often directed to engineering which is expected to lead the response effort when the technical basis for decisions is involved. Engineering evaluations are detailed and very rigorous. They are focused on the effects on safety and the accident analyses of the Safety Analysis Reports and they are based on codes and standards committed to by the NRC certificate holder.

Establish Configuration Control of equipment and records: Configuration management in most DOE facilities is not always well-defined programmatically or well implemented. It is a strong emphasis under NRC. It is not enough to create work processes that are well defined and implemented at a given point in time, but it is crucial that these work processes be maintained in the desired configuration. The secret to configuration control is excellent change control! Changes in work processes that are not approved and documented will undermine plant configuration and erode the technical basis and safety margins.

Under NRC regulation, the plant was first required to perform a thorough assessment of potential accidents and consequences. The plant was then required to identify equipment, facilities, and management controls which will be used to minimize risk to workers and the public from potential accidents. Configuration management is the implementing program to assure these identified safety equipment, facilities, and controls are not unintentionally degraded. It also helps assure that NRC regulatory requirements to establish and maintain ASME NQA-1 Quality Assurance requirements are fully met. Items typically included under configuration management are plant modifications, drawings, procedures, procurement specifications, work control practices such as work packages, "like for like" equipment replacements, and training qualifications. As a matter of practice, configuration management is also applied in a graded approach to non-safety plant equipment and facilities. It is further essential to support configuration management with excellent records management. Records management assures the existence, flow, and communication of up-to-date records and relevant documents.

Install a strong problem reporting system: Self-assessment is the single most important change in transition from DOE to NRC. Although there are more aspects to the transition, the problem reporting system is the cornerstone of self-assessment because it is the primary opportunity for the frontline manager and worker to get involved in identifying deficiencies. It takes a very well-organized, determined, and sustained effort to implement an NRC-acceptable problem reporting system in a former DOE plant. Under DOE, the Paducah Plant logged approximately 600 reportable problems in the last year prior to the beginning of the transition. After implementation of the NRC-regulated commercial nuclear-type reporting structure, more than 6000 problems were reported in the first year of operation. Today, that number is 8000 per year and represents a superb example of focusing on smaller problems to avoid larger, more

serious problems. Additional significant benefits come from the Paducah approach to problem reporting. Each of the 8000 problems reports filed by the workforce has a section where the individual can suggest how the problem can be solved. In effect, the problem reporting system is also a suggestion system and we get approximately 8000 employee suggestions per year!

In a successful problem reporting system:

- The report form must be simple to use,
- Potential safety concerns must be quickly recognized,
- There must be an effective prioritization method,
- Assignment of responsibility for disposition must be clear,
- Communication back to the person filing the report must be prompt and effective, and
- Fixes must be permanent.

In the following approach, it was found that more serious events of the past actually contained many smaller problems that were identified after the failure during event investigation. These smaller problems should have been clear precursors or contributors to subsequent major events. If problem reporting is successful in timely identification and correction of the smaller problems, big ones are avoided. This, along with NRC credit for self-identifying, is a major safety and economic payoff for having a highly effective problem reporting.

Use scientific root cause to assure corrective actions are effective: A key link to assure problems are fixed the first time they are identified is having a reliable root-cause process which is proceduralized and utilized. It is vital that senior and middle managers in the facility be fully trained to understand and determine root causes of problems so they can assure that more than symptoms are being addressed. Although the goal is 95 percent plus, the implementation of scientific root-cause analysis process thus far has moved the Paducah Plant from corrective action effectiveness of considerably less than 50 percent to between 80 – 90 percent. An effective root-cause system must identify both system causes and human factor causes in an accurate and consistent manner. Then, line management must assure that corrective actions are selected and implemented that will fully counteract the root causes identified. Unlike DOE, NRC will absolutely insist that management identify root cause and implement corrective actions that fix the problem once. Repeats are not tolerated.

Foster a universal practice of “Follow the procedure or stop the job”: NRC views following plant procedures as a commitment because they contain requirements flowed down from the certification basis. Initially, when the transition started, the procedures contained both technical and administrative errors. This was, in some instances, the case at Paducah even after 1500 procedures were programmatically rewritten! By setting strong management expectation that people always follow the procedure or stop the job if there is a non-performable step, errors have gradually been removed and eventually procedures become error-free. The concept of the “non-performable step” was introduced such that administrative errors like typos did not require stopping the job. However, it did require the more trivial change be marked and corrected in the next general revision to the procedure. ONLY by closely following procedures is the job done as fully intended, NRC compliance met, and mistakes removed from the procedures. Implementation of this expectation was accompanied, in some instances, by disciplinary actions which were initially required in order to enforce the message.

Conduct high quality compliance and skill training: Of the three “basics” of plant operation (self-assessments, procedures, and training), training is one of the most difficult to perfect because it requires resources that are not initially present in most plants. The primary difference in training under DOE compared to NRC is the high degree of line management acceptance required under the latter. Quality training is impossible to achieve without strong line management support because qualified trainers with the desired trainer experience cannot usually be attained from outside contractors. This leaves the need to use mostly in-house subject matter experts as trainers who the line organizations are not very willing to give up. In addition to this obstacle, these in-house experts are not typically sufficiently effective teachers or communicators. Other barriers include the difficulty experienced by the line organization in managing their workload while releasing frontline workers as trainees (and the ever-present barrier that no one likes to go to school!). For training to succeed, its line organization must see training as part of the job and not something “extra” to do. With this proper attitude present in the students, the training organization must meet the challenge by providing outstanding instructors and instructional material. Training excellence must be provided by the management team to address the inevitable initial basic lack of knowledge. Training must also be basic driving force in changing attitude and practices toward the required NRC rigor. In other words, under NRC, training is required to drive the other nine “must-do’s” and to embed the thinking contained in the five NRC distinctions previously listed.

Implementing and utilize modern work control practices with emphasis on safety: Modern work control is not found in most DOE facilities. Work control has six elements: work identification, prioritization, planning, scheduling, execution, and closeout. At Paducah, plantwide prioritization was inconsistent, planning was very inadequate, and working to strict schedules was not the norm. Because there are so many requirements necessary to do the job safely and effectively, a strong integration method such as work control is mandatory. Work control, done properly, meets NRC rigor, brings together all the requirements into one physical element called a work package, and plans quality into the job. High quality work done on each task will assure both safety and productivity. Too often, safety and production are seen as diametrically opposed objectives. Plant personnel initially believe that striving to work safely defeats productivity. Work control is one of the important approaches that provides an alternative to this safety or production mentality. The work package can effectively control the job such that it is performed safely and effectively. Under excellent work control, quality work is enhanced which provides both safety and production payoff simultaneously!

Embed Conduct of Operations in the entire plant: Meticulous attention to detail is necessary to succeed in complex industrial systems such as a nuclear facility. This attention to detail is best obtained by having a structured approach to do production work. When there is a defined approach, such as Conduct of Operations and Maintenance, not only are there agreed upon standards to work to, but constant improvement can take place in the system. Because sloppy operation degrades both safety and production performance, “Conduct of,” when practiced carefully, will reduce unwanted events and enhance production. Just as part-to-part variations cause poor quality in manufacturing, variations in methods from one time to the next cause poor quality in nuclear processes. DOE generally supports implementation of “Conduct of” but is sometimes inconsistent in its expectations regarding implementation over time. The most effectively implement “Conduct of” programs are those introduced into the commercial nuclear power plants following the Three Mile Island accident. Refined over a period of several years by

the Institute of Nuclear Power Operations, the programs are essentially a collection of best practices for work performed under modern nuclear safety standards.

While these ten “must do’s” are truly essential for survival, there are additional things found in the Paducah experience that enhance performance. These have been labeled as “ought to’s”. Without elaboration of these, for the Paducah Plant transition, there were some actions shown below which significantly assisted in implementation and transition of the workforce to support the regulatory and production changes. They were:

- Develop a simple vision which is shared image of a desired future understood by all workers
- Develop a coaching program using carefully selected outsiders with NRC and commercial backgrounds
- Use these coaches to tutor managers on how to sharpen their skills and to help identify people who refuse to change so they can be removed
- Use work teams to attack multifunction problems and simply to get workers involved
- Use performance indicators and respond to early trends
- Establish a comprehensive improvement plan that moves responsibility out to the first line supervisor and first line worker
- Develop and practice a structured approach to communication
- Develop an intense questioning attitude and practice in all hands
- Recognize and reward success
- Use process simplification and cycle time reduction process to “speed up the slow down” caused by implementing so many new management systems and changes at one time!
- Benchmark NRC-regulated facilities

The Paducah experience, with transition, cost over \$100 million and involved a 2300-page application for NRC certification approval. There were over 6000 specific requirements which had to be inserted in plant procedures. Fifteen hundred procedures were rewritten requiring almost 200,000 man-hours. Eight “blue chip” coaches were hired for two years in a coaching program designed to quickly instill NRC and commercial nuclear practices. The coaches were also used to help evaluate individual manager’s ability to successfully change, those who could not make the switch were identified and removed. Fifty percent of the senior management team was replaced with commercial nuclear people over a 2-year period. Perhaps surprisingly, the most astonishing result of the transition was the associate improvement in plant business performance at the same time that Paducah was coming up to speed on NRC regulation. In the three-year transition period, the plant became both an NRC-regulated and more lean and agile product-oriented business.

For successful transition, DOE’s willingness to gradually allow the plant to step-wise become NRC-ready was a great credit to their commitment to make the transition succeed and it was an absolute necessity! This was done in Paducah’s case through a Regulatory Oversight Agreement (ROA) between DOE and the managing corporation. Additionally, the NRC brought its first resident inspector to Paducah in June 1994 as an “observer” to help acquaint the Plant with NRC reality. Compliance became mandatory and enforcement conferences were used by DOE to

escalate adherence to requirements. Although, technically, DOE remained the regulatory authority until the final approval of the certificate, DOE site personnel accommodated the NRC implementation and actually regulated near the end of the transition of its authority much like NRC.

There were some difficult moments! The initial submission of the application for NRC certification in 1995 was rejected because of inadequate commitment to NRC regulations such as 10.CFR.76. With almost two additional years of re-work and strengthening, a 2300-page application was accepted by NRC and they assumed regulatory authority for Nuclear Safety on March 3, 1997. Because of the length of this formal cycle, the cooperative transition in which DOE became an NRC look-alike was essential in keeping the transition process moving forward and in relieving the plant of the potential complexities of management under two different sets of regulating standards. From the four-year transition, the Paducah Plant has “battle scars”, but there are also “battle ribbons”. All the effort to achieve certification and prepare for privatization by becoming more business-like culminated in *Industry Week Magazine*’s recognition of the Paducah Plant as one of the Top 10 Best Plants in America in 1997, recognition of the Paducah Plant by the State of Kentucky as one of the top three Kentucky plants in health and safety, recognition of it by the Governor of Kentucky as one of the top five plants in quality of operations in the state in 1997, and, in 1998, the Plant was selected by a U. S. and Japanese International Safety group as one of five plants that had made the best combined safety-productivity improvements. Transition is difficult but the pursuit of nuclear safety excellence in operations and business performance does have rewards!