Saprodani Associates

177 US Hwy 1N, Unit 212, Tequesta, Florida 33469
Phone:1-561-972-8363 Email:saprodani@gmail.com

Petitioner's Exhibit-4

Saprodani Associates

177 US Hwy 1N, Unit 212, Tequesta, Florida 33469
Phone:1-561-972-8363 Email:saprodani@gmail.com

AP Aging Nukes (Part-1)

Nuclear Regulatory Commission via AP
Rusted piping at the Byron nuclear plant in Illinois caused this 10-gallon-per-minute leak in Oct. 19, 2007. The water from the pipe cools the reactor in an emergency. The plant was immediately taken offline for repairs.

By JEFF DONN
Associated Press

updated 6/20/2011 11:21:43 AM ET

Part II of this series will appear on Tuesday and looks at corroded, buried piping that represent an escalating problem: 75 percent of the nuclear plant sites have experienced radioactive tritium leaks, often into groundwater.

LACEY TOWNSHIP, N.J. — Federal regulators have been working closely with the nuclear power industry to keep the nation's aging reactors operating within safety standards by repeatedly weakening those standards, or simply failing to enforce them, an investigation by The Associated Press has found.

Time after time, officials at the U.S. Nuclear Regulatory Commission have decided that original regulations were too strict, arguing that safety margins could be eased without peril, according to records and interviews.

The result? Rising fears that these accommodations by the NRC are significantly undermining safety — and inching the reactors closer to an accident that could harm the public and jeopardize the future of nuclear power in the United States.

Examples abound. When valves leaked, more leakage was allowed — up to 20 times the original limit. When rampant cracking caused radioactive leaks from steam generator tubing, an easier test of the tubes was devised, so plants could meet standards.

Failed cables. Busted seals. Broken nozzles, clogged screens, cracked concrete, dented containers, corroded metals and rusty underground pipes — all of these and thousands of other problems linked to aging were uncovered in the AP's yearlong investigation. And all of them could escalate dangers in the event of an accident.

Yet despite the many problems linked to aging, not a single official body in government or industry has studied the overall frequency and potential impact on safety of such breakdowns in recent years, even as the NRC has extended the licenses of dozens of reactors.

Industry and government officials defend their actions, and insist that no chances are being taken. But the AP investigation found that with billions of dollars and 19 percent of America's electricity supply at stake, a cozy relationship prevails between the industry and its regulator, the NRC.

Records show a recurring pattern: Reactor parts or systems fall out of compliance with the rules. Studies are conducted by the industry and government, and all agree that existing standards are "unnecessarily conservative."

Regulations are loosened, and the reactors are back in compliance.

"That's what they say for everything, whether that's the case or not," said Demetrios Basdekas, an engineer retired from the NRC. "Every time you turn around, they say 'We have all this built-in conservatism.'"

The ongoing crisis at the stricken, decades-old Fukushima Dai-ichi nuclear facility in Japan has focused attention on the safety of plants elsewhere in the world; it prompted the NRC to look at U.S. reactors, and a report is due in July. But the factor of aging goes far beyond the issues posed by the disaster at Fukushima.

Commercial nuclear reactors in the United States were designed and licensed for 40 years. When the first ones were being built in the 1960s and 1970s, it was expected that they would be replaced with improved models long before those licenses expired.

Interactive: Population within 10 and 50 miles of nuclear power (on this page)

But that never happened. The 1979 accident at Three Mile Island, massive cost overruns, crushing debt and high interest rates ended new construction proposals for several decades.

Instead, 66 of the 104 operating units have been relicensed for 20 more years, mostly with scant public attention. Renewal applications are under review for 16 other reactors.

By the standards in place when they were built, these reactors are old and getting older. As of today, 82 reactors are more than 25 years old.

The AP found proof that aging reactors have been allowed to run less safely to prolong operations. As equipment has approached or violated safety limits, regulators and reactor operators have loosened or bent the rules.

Last year, the NRC weakened the safety margin for acceptable radiation damage to reactor vessels — for a second time. The standard is based on a measurement known as a reactor vessel's "reference temperature," which predicts when it will become dangerously brittle and vulnerable to failure. Over the years, many plants have violated or come close to violating the standard.

As a result, the minimum standard was relaxed first by raising the reference temperature 50 percent, and then 78 percent above the original — even though a broken vessel could spill its radioactive contents into the environment.

"We've seen the pattern," said nuclear safety scientist Dana Powers, who works for Sandia National Laboratories and also sits on an NRC advisory committee. "They're ... trying to get more and more out of these plants."

Sharpening the pencil

The AP collected and analyzed government and industry documents — including some never-before released. The examination looked at both types of reactor designs: pressurized water units that keep radioactivity confined to the reactor building and the less common boiling water types like those at Fukushima, which send radioactive water away from the reactor to drive electricity-generating turbines.

Tens of thousands of pages of government and industry studies were examined, along with test results, inspection reports and regulatory policy statements filed over four decades. Interviews were conducted with scores of managers, regulators, engineers, scientists, whistleblowers, activists, and residents living near the reactors, which are located at 65 sites, mostly in the East and Midwest.

AP reporting teams toured some of the oldest reactors — the unit here at Oyster Creek, near the Atlantic coast 50 miles east of Philadelphia, and two units at Indian Point, 25 miles north of New York City along the Hudson River.

Map: Nuclear plants susceptible to blackouts (on this page)

Called "Oyster Creak" by some critics because of its aging problems, this boiling water reactor began running in 1969 and ranks as the country's oldest operating commercial nuclear power plant. Its license was extended in 2009 until 2029, though utility officials announced in December that they'll shut the reactor 10 years earlier rather than build state-ordered cooling towers. Applications to extend the lives of pressurized water units 2 and 3 at Indian Point, each

more than 36 years old, are under review by the NRC.

Unprompted, several nuclear engineers and former regulators used nearly identical terminology to describe how industry and government research has frequently justified loosening safety standards to keep aging reactors within operating rules. They call the approach "sharpening the pencil" or "pencil engineering" — the fudging of calculations and assumptions to yield answers that enable plants with deteriorating conditions to remain in compliance.

"Many utilities are doing that sort of thing," said engineer Richard T. Lahey Jr., who used to design nuclear safety systems for General Electric Co., which makes boiling water reactors. "I think we need nuclear power, but we can't compromise on safety. I think the vulnerability is on these older plants."

Added Paul Blanch, an engineer who left the industry over safety issues but later returned to work on solving them: "It's a philosophical position that (federal regulators) take that's driven by the industry and by the economics: What do we need to do to let those plants continue to operate? They somehow sharpen their pencil to either modify their interpretation of the regulations, or they modify their assumptions in the risk assessment."

In public pronouncements, industry and government say aging is well under control. "I see an effort on the part of this agency to always make sure that we're doing the right things for safety. I'm not sure that I see a pattern of staff simply doing things because there's an interest to reduce requirements — that's certainly not the case," NRC chairman Gregory Jaczko said in an interview at agency headquarters in Rockville, Md.

Neil Wilmshurst, director of plant technology for the industry's Electric Power Research Institute, acknowledged that the industry and NRC often collaborate on research that supports rule changes. But he maintained that there's "no kind of misplaced alliance ... to get the right answer."

Yet agency staff, plant operators, and consultants paint a different picture in little-known reports, where evidence of industry-wide problems is striking:

- ❿ The AP reviewed 226 preliminary notifications — alerts on emerging safety problems — issued by the NRC since 2005. Wear and tear in the form of clogged lines, cracked parts, leaky seals, rust and other deterioration contributed to at least 26 alerts over the past six years. Other notifications lack detail, but aging also was a probable factor in 113 additional alerts. That would constitute up to 62 percent in all. For example, the 39-year-old Palisades reactor in Michigan shut Jan. 22 when an electrical cable failed, a fuse blew, and a valve stuck shut, expelling steam with low levels of radioactive tritium into the air outside. And a one-inch crack in a valve weld aborted a restart in February at the LaSalle site west of Chicago.
- ❿ One 2008 NRC report blamed 70 percent of potentially serious safety problems on "degraded conditions." Some involve human factors, but many stem from equipment wear, including cracked nozzles, loose paint, electrical problems, or offline cooling components.

❿ Confronted with worn parts that need maintenance, the industry has repeatedly requested — and regulators have often allowed — inspections and repairs to be delayed for months until scheduled refueling outages. Again and again, problems worsened before they were fixed. Postponed inspections inside a steam generator at Indian Point allowed tubing to burst, leading to a radioactive release in 2000. Two years later, cracking was allowed to grow so bad in nozzles on the reactor vessel at the Davis-Besse plant near Toledo, Ohio, that it came within two months of a possible breach, the NRC acknowledged in a report. A hole in the vessel could release radiation into the environment, yet inspections failed to catch the same problem on the replacement vessel head until more nozzles were found to be cracked last year.

Time crumbles things

Nuclear plants are fundamentally no more immune to the incremental abuses of time than our cars or homes: Metals grow weak and rusty, concrete crumbles, paint peels, crud accumulates. Big components like 17-story-tall concrete containment buildings or 800-ton reactor vessels are all but impossible to replace. Smaller parts and systems can be swapped, but still pose risks as a result of weak maintenance and lax regulation or hard-to-predict failures. Even when things are fixed or replaced, the same parts or others nearby often fail later.

Even mundane deterioration at a reactor can carry harsh consequences.

For example, peeling paint and debris can be swept toward pumps that circulate cooling water in a reactor accident. A properly functioning containment building is needed to create air pressure that helps clear those pumps. The fact is, a containment building could fail in a severe accident. Yet the NRC has allowed operators to make safety calculations that assume containment buildings will hold.

In a 2009 letter, Mario V. Bonaca, then-chairman of the NRC's Advisory Committee on Reactor Safeguards, warned that this approach represents "a decrease in the safety margin" and makes a fuel-melting accident more likely. At Fukushima, hydrogen explosions blew apart two of six containment buildings, allowing radiation to escape from overheated fuel in storage pools.

Many photos in NRC archives — some released in response to AP requests under the federal Freedom of Information Act — show rust accumulated in a thick crust or paint peeling in long sheets on untended equipment at nuclear plants. Other breakdowns can't be observed or predicted, even with sophisticated analytic methods — especially for buried, hidden or hard-to-reach parts.

Industry and government reports are packed with troubling evidence of unrelenting wear — and repeated regulatory compromises.

Four areas stand out:

Brittle vessels. For years, operators have rearranged fuel rods to limit gradual radiation damage to the steel vessels protecting the core and to keep them strong enough to meet safety standards.

It hasn't worked well enough.

Even with last year's weakening of the safety margins, engineers and metal scientists say some plants may be forced to close over these concerns before their licenses run out — unless, of course, new compromises with regulations are made. But the stakes are high: A vessel damaged by radiation becomes brittle and prone to cracking in certain accidents at pressurized water reactors, potentially releasing its radioactive contents into the environment.

Leaky valves. Operators have repeatedly violated leakage standards for valves designed to bottle up radioactive steam in the event of earthquakes and other accidents at boiling water reactors.

Many plants have found they could not adhere to the general standard allowing each of these parts — known as main steam isolation valves — to leak at a rate of no more than 11.5 cubic feet per hour. In 1999, the NRC decided to permit individual plants to seek amendments of up to 200 cubic feet per hour for all four steam valves combined.

But plants keep violating even those higher limits. For example, in 2007, Hatch Unit 2, in Baxley, Ga., reported combined leakage of 574 cubic feet per hour.

Cracked tubing. The industry has long known of cracking in steel alloy tubing originally used in the steam generators of pressurized water reactors. Ruptures were rampant in these tubes containing radioactive coolant; in 1993 alone, there were seven. Even today, as many as 18 reactors are still running on old generators.

Problems can arise even in a newer metal alloy, according to a report of a 2008 industry-government workshop.

Corroded piping. Nuclear operators have failed to stop an epidemic of leaks in pipes and other underground equipment in damp settings. The country's nuclear sites have suffered more than 400 accidental radioactive leaks during their history, the activist Union of Concerned Scientists reported in September.

Plant operators have been drilling monitoring wells and patching hidden or buried piping and other equipment for several years to control an escalating outbreak.

Here, too, they have failed. Between 2000 and 2009, the annual number of leaks from underground piping shot up fivefold, according to an internal industry document obtained and analyzed by the AP.

Long-standing concerns

Even as they reassured the public, regulators have been worrying about aging reactors since at least the 1980s, when the first ones were entering only their second decade of operation. A 1984 report for the NRC blamed wear, corrosion, crud and fatigue for more than a third of 3,098 failures of parts or systems within the first 12 years of industry operations; the authors believed the number was actually much higher.

A decade later, in 1994, the NRC reported to Congress that the critical shrouds lining reactor cores were cracked at a minimum of 11 units, including five with extensive damage. The NRC ordered more aggressive maintenance, but an agency report last year said cracking of internal

core components — spurred by radiation — remains "a major concern" in boiling water reactors.

A 1995 study by Oak Ridge National Laboratory covering a seven-year period found that aging contributed to 19 percent of scenarios that could have ended in severe accidents.

In 2001, the Union of Concerned Scientists, which does not oppose nuclear power, told Congress that aging problems had shut reactors eight times within 13 months.

Map: Spent nuclear fuel (on this page)

And an NRC presentation for an international workshop that same year warned of escalating wear at reactor buildings meant to bottle up radiation during accidents. A total of 66 cases of damage were cited in the presentation, with corrosion reported at a quarter of all containment buildings. In at least two cases — at the two-reactor North Anna site 40 miles northwest of Richmond, Va., and the two-unit Brunswick facility near Wilmington, N.C. — steel containment liners designed to shield the public had rusted through.

And in 2009, a one-third-inch hole was discovered in a liner at Beaver Valley Unit 1 in Shippingport, Pa.

Long-standing, unresolved problems persist with electrical cables, too.

In a 1993 report labeled "official use only," an NRC staffer warned that electrical parts throughout plants were subject to dangerous age-related breakdowns unforeseen by the agency. Almost a fifth of cables failed in testing that simulated the effects of 40 years of wear. The report warned that as a result, reactor core damage could occur much more often than expected.

Fifteen years later, the problem appeared to have worsened. An NRC report warned in 2008 that rising numbers of electrical cables are failing with age, prompting temporary shutdowns and degrading safety. Agency staff tallied 269 known failures over the life of the industry.

Two industry-funded reports obtained by the AP said that managers and regulators have worried increasingly about the reliability of sometimes wet, hard-to-reach underground cables over the past five-to-10 years. One of the reports last year acknowledged many electrical-related aging failures at plants around the country.

"Multiple cable circuits may fail when called on to perform functions affecting safety," the report warned.

Eaten away from within

Few aging problems have been more challenging than chemical corrosion from within.

In one of the industry's worst accidents, a corroded pipe burst at Virginia's Surry 2 reactor in 1986 and showered workers with scalding steam, killing four.

In summer 2001, the NRC was confronted with a new problem: Corrosive chemicals were cracking nozzles on reactors. But the NRC let operators delay inspections to coincide with scheduled outages. Inspection finally took place in February 2002 at the Davis-Besse unit in Ohio.

What workers found shocked the industry.

They discovered extensive cracking and a place where acidic boron had spurted from the reactor and eaten a gouge as big as a football. When the problem was found, just a fraction of an inch of inner lining remained. An NRC analysis determined that the vessel head could have burst within two months — what former NRC Commissioner Peter Bradford has called a "near rupture" which could have released large amounts of radiation into the environment.

In 2001-3 alone, at least 10 plants developed these cracks, according to an NRC analysis.

Industry defenders blame human failings at Davis-Besse. Owner FirstEnergy Corp. paid a $28 million fine, and courts convicted two plant employees of hiding the deterioration. NRC spokesman Scott Burnell declared that the agency "learned from the incident and improved resident inspector training and knowledge-sharing to ensure that such a situation is never repeated."

Yet on the same March day last year that Burnell's comments were released, Davis-Besse workers again found dried boron on the nozzles of a replacement vessel head, indicating more leaks. Inspecting further, they again found cracks in 24 of 69 nozzles.

"We were not expecting this issue," said plant spokesman Todd Schneider.

In August, the operator applied for a 20-year license extension. Under pressure from the NRC, the company has agreed to replace the replacement head in October.

As far back as the 1990s, the industry and NRC also were well aware that the steel-alloy tubing in many steam generators was subject to chemical corrosion. It could crack over time, releasing radioactive gases that can bypass the containment building. If too much spurts out, there may be too little water to cool down the reactor, prompting a core melt.

In 1993, NRC personnel reported seven outright ruptures inside the generators, several forced outages per year, and some complete replacements. Personnel at the Catawba plant near Charlotte, N.C., found more than 8,000 corroded tubes — more than half its total.

For plants with their original generators, "there is no end in sight to the steam generator tube degradation problems," a top agency manager declared. NRC staffers warned: "Crack depth is difficult to measure reliably and the crack growth rate is difficult to determine."

Yet no broad order was issued for shutdowns to inspect generators.

Instead, the staff began to talk to operators about how to deal with the standard that no cracks could go deeper than 40 percent through the tube wall.

In 1995, the NRC staff put out alternative criteria that let reactors keep running if they could reach positive results with remote checks known as "eddy-currents tests." The new test standard gave more breathing room to reactors.

According to a 2001 report by the Advisory Committee on Reactor Safeguards, the staff "acknowledged that there would be some possibility that cracks of objectionable depth might be

overlooked and left in the steam generator for an additional operating cycle." The alternative, the report said, would be to repair or remove potentially many tubes from service.

NRC engineer Joe Hopenfeld, who had worked previously in the industry, challenged this approach at the time from within the agency. He warned that multiple ruptures in corroded tubing could release radiation. The NRC said radiation would be confined.

Hopenfeld now says this conclusion wasn't based on solid analysis but "wishful thinking" and research meant to reach a certain conclusion — another instance of "sharpening the pencil."

"It was a hard problem to solve, and they did not want to say it was a problem, because if they really said it was a problem, they would have to shut down a lot of reactors."

Age is no issue, says industry

With financial pressures mounting in the 1990s to extend the life of aging reactors, new NRC calculations using something called the "Master Curve" put questionable reactor vessels back into the safe zone.

A 1999 NRC review of the Master Curve, used to analyze metal toughness, noted that energy deregulation had put financial pressure on nuclear plants. It went on: "So utility executives are considering new operational scenarios, some of which were unheard of as little as five years ago: extending the licensed life of the plant beyond 40 years." As a result, it said, the industry and the NRC were considering "refinements" of embrittlement calculations "with an eye to reducing known over-conservatisms."

Asked about references to economic pressures, NRC spokesman Burnell said motivations are irrelevant if a technology works.

Former NRC commissioner Peter Lyons said, "There certainly is plenty of research ... to support a relaxation of the conservativisms that had been built in before. I don't see that as decreasing safety. I see that as an appropriate standard."

Though some parts are too big and too expensive to replace, industry defenders also point out that many others are routinely replaced over the years.

Tony Pietrangelo, chief nuclear officer of the industry's Nuclear Energy Institute, acknowledges that you'd expect to see a growing failure rate at some point — "if we didn't replace and do consistent maintenance."

In a sense, then, supporters of aging nukes say an old reactor is essentially a collection of new parts.

"When a plant gets to be 40 years old, about the only thing that's 40 years old is the ink on the license," said NRC chief spokesman Eliot Brenner. "Most, if not all of the major components, will have been changed out."

Oyster Creek spokesman David Benson said the reactor "is as safe today as when it was built."

Yet plant officials have been trying to arrest rust on its 100-foot-high, radiation-blocking steel

drywell for decades. The problem was declared solved long ago, but a rust patch was found again in late 2008. Benson said the new rust was only the size of a dime, but acknowledged there was "some indication of water getting in."

In an effort to meet safety standards, aging reactors have been forced to come up with backfit on top of backfit.

As Ivan Selin, a retired NRC chairman, put it: "It's as if we were all driving Model T's today and trying to bring them up to current mileage standards."

For example, the state of New Jersey — not the NRC — had ordered Oyster Creek to build cooling towers to protect sea life in nearby Barnegat Bay. Owner Exelon Corp. said that would cost about $750 million and force it to close the reactor — 20-year license extension notwithstanding. Even with the announcement to close in 2019, Oyster Creek will have been in operation for 50 years.

Many of the safety changes have been justified by something called "risk-informed" analysis, which the industry has employed widely since the 1990s: Regulators set aside a strict check list applied to all systems and focus instead on features deemed to carry the highest risk.

But one flaw of risk-informed analysis is that it doesn't explicitly account for age. An older reactor is not viewed as inherently more unpredictable than a younger one. Ed Lyman, a physicist with the Union of Concerned Scientists, says risk-informed analysis has usually served "to weaken regulations, rather than strengthen them."

Even without the right research, the NRC has long reserved legal wiggle room to enforce procedures, rules and standards as it sees fit. A 2008 position paper by the industry group EPRI said the approach has brought "a more tractable enforcement process and a significant reduction in the number of cited violations."

But some safety experts call it "tombstone regulation," implying that problems fester until something goes very wrong. "Until there are tombstones, they don't regulate," said Blanch, the longtime industry engineer who became a whistleblower.

Barry Bendar, a database administrator who lives one mile from Oyster Creek, said representatives of Exelon were asked at a public meeting in 2009 if the plant had a specific life span.

"Their answer was, 'No, we can fix it, we can replace, we can patch,'" said Bendar. "To me, everything reaches an end of its life span."

Saprodani Associates

177 US Hwy 1N, Unit 212, Tequesta, Florida 33469
Phone:1-561-972-8363 Email:saprodani@gmail.com

AP Aging Nukes (Part-2)

By JEFF DONN
Associated Press

updated 6/21/2011 5:48:09 AM ET

BRACEVILLE, Ill. — Radioactive tritium has leaked from three-quarters of U.S. commercial nuclear power sites, often into groundwater from corroded, buried piping, an Associated Press investigation shows.

The number and severity of the leaks has been escalating, even as federal regulators extend the licenses of more and more reactors across the nation.

Tritium, which is a radioactive form of hydrogen, has leaked from at least 48 of 65 sites, according to U.S. Nuclear Regulatory Commission records reviewed as part of the AP's yearlong examination of safety issues at aging nuclear power plants.

Leaks from at least 37 of those facilities contained concentrations exceeding the federal drinking water standard — sometimes at hundreds of times the limit. While most leaks have been found within plant boundaries, some have migrated offsite. But none is known to have reached public water supplies.

At three sites — two in Illinois and one in Minnesota — leaks have contaminated drinking wells of nearby homes, the records show, but not at levels violating the drinking water standard.

At a fourth site, in New Jersey, tritium has leaked into an aquifer and a discharge canal feeding picturesque Barnegat Bay off the Atlantic Ocean.

Story: GAO: leaks at aging nuke sites difficult to detect

Previously, the AP reported that regulators and industry have weakened safety standards for decades to keep the nation's commercial nuclear reactors operating within the rules.

While NRC officials and plant operators argue that safety margins can be eased without peril, critics say these accommodations are inching the reactors closer to an accident.

Any exposure to radioactivity, no matter how slight, boosts cancer risk, according to the National Academy of Sciences. Federal regulators set a limit for how much tritium is allowed in drinking water. So far, federal and industry officials say, the tritium leaks pose no health threat.

But it's hard to know how far some leaks have traveled into groundwater. Tritium moves through soil quickly, and when it is detected it often indicates the presence of more powerful radioactive isotopes that are often spilled at the same time.

For example, cesium-137 turned up with tritium at the Fort Calhoun nuclear unit near Omaha, Neb., in 2007. Strontium-90 was discovered with tritium two years earlier at the Indian Point nuclear power complex, where two reactors operate 25 miles north of New York City.

Interactive: Population within 10 and 50 miles of nuclear power (on this page)

The tritium leaks also have spurred doubts among independent engineers about the reliability of emergency safety systems at the 104 nuclear reactors situated on the 65 sites.

That's partly because some of the leaky underground pipes carry water meant to cool a reactor in an emergency shutdown and to prevent a meltdown. More than a mile of piping, much of it encased in concrete, can lie beneath a reactor.

Tritium is relatively short-lived and penetrates the body weakly through the air compared to other radioactive contaminants. Each of the known releases has been less radioactive than a single X-ray.

The main health risk from tritium, though, would be in drinking water. The U.S. Environmental Protection Agency says tritium should measure no more than 20,000 picocuries per liter in drinking water. The agency estimates seven of 200,000 people who drink such water for decades would develop cancer.

Still, the NRC and industry consider the leaks a public relations problem, not a public health or accident threat, records and interviews show.

"The public health and safety impact of this is next to zero," said Tony Pietrangelo, chief nuclear officer of the industry's Nuclear Energy Institute. "This is a public confidence issue."

—

Leaks are prolific

Like rust under a car, corrosion has propagated for decades along the hard-to-reach, wet underbellies of the reactors — generally built in a burst of construction during the 1960s and 1970s. As part of an investigation of aging problems at the country's nuclear reactors, the AP uncovered evidence that despite government and industry programs to bring the causes of such leaks under control, breaches have become more frequent and widespread.

There were 38 leaks from underground piping between 2000 and 2009, according to an industry document presented at a tritium conference. Nearly two-thirds of the leaks were reported over the latest five years.

Here are some examples:

- At the three-unit Browns Ferry complex in Alabama, a valve was mistakenly left open in a storage tank during modifications over the years. When the tank was filled in April 2010 about 1,000 gallons of tritium-laden water poured onto the ground at a concentration of 2 million picocuries per liter. In drinking water, that would be 100 times higher than the EPA health standard.
- At the LaSalle site west of Chicago, tritium-laden water was accidentally released from a storage tank in July 2010 at a concentration of 715,000 picocuries per liter — 36 times the EPA standard.
- The year before, 123,000 picocuries per liter were detected in a well near the turbine building at Peach Bottom west of Philadelphia — six times the drinking water standard.

❿ And in 2008, 7.5 million picocuries per liter leaked from underground piping at Quad Cities in western Illinois — 375 times the EPA limit.

Subsurface water not only rusts underground pipes, it attacks other buried components, including electrical cables that carry signals to control operations. They too have been failing at high rates.

A 2008 NRC staff memo reported industry data showing 83 failed cables between 21 and 30 years of service — but only 40 within their first 10 years of service. Underground cabling set in concrete can be extraordinarily difficult to replace.

Under NRC rules, tiny concentrations of tritium and other contaminants are routinely released in monitored increments from nuclear plants; leaks from corroded pipes are not permitted.

The leaks sometimes go undiscovered for years, the AP found. Many of the pipes or tanks have been patched, and contaminated soil and water have been removed in some places. But leaks are often discovered later from other nearby piping, tanks or vaults.

Mistakes and defective material have contributed to some leaks. However, corrosion — from decades of use and deterioration — is the main cause. And, safety engineers say, the rash of leaks suggest nuclear operators are hard put to maintain the decades-old systems.

Story: Safety rules loosened for aging nuclear reactors

Over the history of the U.S. industry, more than 400 known radioactive leaks of all kinds of substances have occurred, the activist Union of Concerned Scientists reported in September.

Several notable leaks above the EPA drinking-water limit for tritium happened five or more years ago, and from underground piping: 397,000 picocuries per liter at Tennessee's Watts Bar unit in 2005 — 20 times the EPA standard; four million at the two-reactor Hatch plant in Georgia in 2003 — 200 times the limit; 750,000 at Seabrook in New Hampshire in 1999 — nearly 38 times the standard; and 4.2 million at the three-unit Palo Verde facility in Arizona, in 1993 — 210 times the drinking-water limit.

Many safety experts worry about what the leaks suggest about the condition of miles of piping beneath the reactors. "Any leak is a problem because you have the leak itself — but it also says something about the piping," said Mario V. Bonaca, a former member of the NRC's Advisory Committee on Reactor Safeguards. "Evidently something has to be done."

Interactive: Aging nuclear plants (on this page)

However, even with the best probes, it is hard to pinpoint partial cracks or damage in skinny pipes or bends. The industry tends to inspect piping when it must be dug up for some other reason. Even when leaks are detected, repairs may be postponed for up to two years with the NRC's blessing.

"You got pipes that have been buried underground for 30 or 40 years, and they've never been inspected, and the NRC is looking the other way," said engineer Paul Blanch, who has worked for the industry and later became a whistleblower. "They could have corrosion all over the place."

Nuclear engineer Bill Corcoran, an industry consultant who has taught NRC personnel how to analyze the cause of accidents, said that since much of the piping is inaccessible and carries cooling water, the worry is if the pipes leak, there could be a meltdown.

—

East Coast issues

One of the highest known tritium readings was discovered in 2002 at the Salem nuclear plant in Lower Alloways Creek Township, N.J. Tritium leaks from the spent fuel pool contaminated groundwater under the facility — located on an island in Delaware Bay — at a concentration of 15 million picocuries per liter. That's 750 times the EPA drinking water limit. According to NRC records, the tritium readings last year still exceeded EPA drinking water standards.

And tritium found separately in an onsite storm drain system measured 1 million picocuries per liter in April 2010.

Also last year, the operator, PSEG Nuclear, discovered 680 feet of corroded, buried pipe that is supposed to carry cooling water to Salem Unit 1 in an accident, according to an NRC report. Some had worn down to a quarter of its minimum required thickness, though no leaks were found. The piping was dug up and replaced.

The operator had not visually inspected the piping — the surest way to find corrosion— since the reactor went on line in 1977, according to the NRC. PSEG Nuclear was found to be in violation of NRC rules because it hadn't even tested the piping since 1988.

Last year, the Vermont Senate was so troubled by tritium leaks as high as 2.5 million picocuries per liter at the Vermont Yankee reactor in southern Vermont (125 times the EPA drinking-water standard) that it voted to block relicensing — a power that the Legislature holds in that state.

Activists placed a bogus ad on the Web to sell Vermont Yankee, calling it a "quaint Vermont fixer-upper from the last millennium" with "tasty, pre-tritiated drinking water."

The gloating didn't last. In March, the NRC granted the plant a 20-year license extension, despite the state opposition. Weeks ago, operator Entergy sued Vermont in federal court, challenging its authority to force the plant to close.

Map: Nuclear blackout (on this page)

At 41-year-old Oyster Creek in southern New Jersey, the country's oldest operating reactor, the latest tritium troubles started in April 2009, a week after it was relicensed for 20 more years. That's when plant workers discovered tritium by chance in about 3,000 gallons of water that had leaked into a concrete vault housing electrical lines.

Since then, workers have found leaking tritium three more times at concentrations up to 10.8 million picocuries per liter — 540 times the EPA's drinking water limit — according to the New Jersey Department of Environmental Protection. None has been directly measured in drinking water, but it has been found in an aquifer and in a canal discharging into nearby Barnegat Bay, a popular spot for swimming, boating and fishing.

An earlier leak came from a network of pipes where rust was first discovered in 1991. Multiple holes were found, "indicating the potential for extensive corrosion," according to an analysis released to an environmental group by the NRC. Yet only patchwork repairs were done.

Tom Fote, who has fished in the bay near Oyster Creek, is unsettled by the leaks. "This was a plant that was up for renewal. It was up to them to make sure it was safe and it was not leaking anything," he said.

Added Richard Webster, an environmental lawyer who challenged relicensing at Oyster Creek: "It's symptomatic of the plants not having a handle on aging."

—

Exelon's piping problems

To Exelon — the country's biggest nuclear operator, with 17 units — piping problems are just a fact of life. At a meeting with regulators in 2009, representatives of Exelon acknowledged that "100 percent verification of piping integrity is not practical," according to a copy of its presentation.

Of course, the company could dig up the pipes and check them out. But that would be costly.

"Excavations have significant impact on plant operations," the company said.

Exelon has had some major leaks. At the company's two-reactor Dresden site west of Chicago, tritium has leaked into the ground at up to 9 million picocuries per liter — 450 times the federal limit for drinking water.

At least four separate problems have been discovered at the 40-year-old site since 2004, when its two reactors were awarded licenses for 20 more years of operation. A leaking section of piping was fixed that year, but another leak sprang nearby within two years, a government inspection report says.

The Dresden leaks developed in systems that help cool the reactor core in an emergency. Leaks also have contaminated offsite drinking water wells, but below the EPA drinking water limit.

There's also been contamination of offsite drinking water wells near the two-unit Prairie Island plant southeast of Minneapolis, then operated by Nuclear Management Co. and now by Xcel Energy, and at Exelon's two-unit Braidwood nuclear facility, 10 miles from Dresden. The offsite tritium concentrations from both facilities also were below the EPA level.

The Prairie Island leak was found in the well of a nearby home in 1989. It was traced to a canal where radioactive waste was discharged.

Braidwood has leaked more than six million gallons of tritium-laden water in repeated leaks dating back to the 1990s — but not publicly reported until 2005. The leaks were traced to pipes that carried limited, monitored discharges of tritium into the river.

"They weren't properly maintained, and some of them had corrosion," said Exelon spokeswoman Krista Lopykinski.

Map: Spent nuclear fuel (on this page)

Last year, Exelon, which has acknowledged violating Illinois state groundwater standards, agreed to pay $1.2 million to settle state and county complaints over the tritium leaks at Braidwood and nearby Dresden and Byron sites. The NRC also sanctioned Exelon.

Tritium measuring 1,500 picocuries per liter turned up in an offsite drinking well at a home near Braidwood.

Though company and industry officials did not view any of the Braidwood concentrations as dangerous, unnerved residents took to bottled water and sued over feared loss of property value. A consolidated lawsuit was dismissed, but Exelon ultimately bought some homes so residents could leave.

Exelon refused to say how much it paid, but a search of county real estate records shows it bought at least nine properties in the contaminated area near Braidwood since 2006 for a total of $6.1 million.

Exelon says it has almost finished cleaning up the contamination, but the cost persists for some neighbors.

Retirees Bob and Nancy Scamen live in a two-story house within a mile of the reactors on 18 bucolic acres they bought in 1988, when Braidwood opened. He had worked there, and in other nuclear plants, as a pipefitter and welder — even sometimes fixing corroded piping. For the longest time, he felt the plants were well-managed and safe.

His feelings have changed.

An outlet from Braidwood's leaky discharge pipe 300 feet from his property poured out three million gallons of water in 1998, according to an NRC inspection report. The couple didn't realize the discharge was radioactive.

The Scamens no longer intend to pass the property on to their grandchildren for fear of hurting their health. The couple just wants out. But the only offer so far is from a buyer who left a note on the front door saying he'd pay the fire-sale price of $10,000.

They say Exelon has refused to buy their home because it has found tritium directly behind, but not beneath, their property.

"They say our property is not contaminated, and if they buy property that is not contaminated, it will set a precedent, and they'll have to buy everybody's property," said Scamen.

Their neighbors, Tom and Judy Zimmer, are also hoping for an offer from Exelon for the land and home they built on it, spending $418,000 for both.

They had just moved into the house in November 2005, and were laying the tile in their new foyer when two Exelon representatives appeared at the door.

Charles Rex Arbogast / AP
Tom Zimmer had just moved into his house when Exelon officials informed him of a tritium leak at the nearby Braidwood Nuclear Power Station in 2005.

"They said, 'We're from Exelon, and we had a tritium spill. It's nothing to worry about,'" recalls Tom Zimmer. "I didn't know what tritium even meant."

But his wife says she understood right away that it was bad news — and they hadn't even emptied their moving boxes yet: "I thought, 'Oh, my God. We're not even in this place. What are we going to do?'"

They say they had an interested buyer who backed out when he learned of the tritium. No one has made an offer since.

—

Public relations effort
The NRC is certainly paying attention. How can it not when local residents fret over every new groundwater incident? But the agency's reports and actions suggest a preoccupation with image and perception.

An NRC task force on tritium leaks last year dismissed the danger to public health. Instead, its report called the leaks "a challenging issue from the perspective of communications around environmental protection." The task force noted ruefully that the rampant leaking had "impacted public confidence."

For sure, the industry also is trying to stop the leaks. For several years now, plant owners around

the country have been drilling more monitoring wells and taking a more aggressive approach in replacing old piping when leaks are suspected or discovered.

For example, Exelon has been performing $14 million worth of work at Oyster Creek to give easier access to 2,000 feet of tritium-carrying piping, said site spokesman David Benson.

But such measures have yet to stop widespread leaking.

Meantime, the reactors keep getting older — 66 have been approved for 20-year extensions to their original 40-year licenses, with 16 more extensions pending.

And, as the AP has been reporting in its ongoing series, Aging Nukes, regulators and industry have worked in concert to loosen safety standards to keep the plants operating.

In an initiative started last year, NRC Chairman Gregory Jaczko asked his staff to examine regulations on buried piping to evaluate if stricter standards or more inspections were needed.

The staff report, issued in June, openly acknowledged that the NRC "has not placed an emphasis on preventing" the leaks.

The authors concluded there are no significant health threats or heightened risk of accidents.

And they predicted even more leaks in the future.

Saprodani Associates

177 US Hwy 1N, Unit 212, Tequesta, Florida 33469
Phone:1-561-972-8363 Email:saprodani@gmail.com

AP Aging Nukes (Part-3)

By JEFF DONN
Associated Press

updated 6/27/2011 1:28:46 PM ET

The last part of this AP series will be published Tuesday and looks at how plants originally billed with a 40-year lifetime have been redefined to stay in use longer.

BUCHANAN, N.Y. — As America's nuclear power plants have aged, the once-rural areas around them have become far more crowded and much more difficult to evacuate. Yet government and industry have paid little heed, even as plants are running at higher power and posing more danger in the event of an accident, an Associated Press investigation has found.

Populations around the facilities have swelled as much as 4½ times since 1980, a computer-assisted population analysis shows. (Msnbc.com last April reported on Census data showing those population shifts).

But some estimates of evacuation times have not been updated in decades, even as the population has increased more than ever imagined. Emergency plans would direct residents to flee on antiquated, two-lane roads that clog hopelessly at rush hour.

And evacuation zones have remained frozen at a 10-mile radius from each plant since they were set in 1978 — despite all that has happened since, including the accidents at Three Mile Island, Chernobyl and Fukushima Dai-ichi in Japan. Meanwhile, the dangers have increased.

More than 90 of the nation's 104 operating reactors have been allowed to run at higher power levels for many years, raising the radiation risk in a major accident. In an ongoing investigative series, the AP has reported that aging plants, their lives extended by industry and regulators, are prone to breakdowns that could lead to accidents.

And because the federal government has failed to find a location for permanent storage of spent fuel, thousands of tons of highly radioactive used reactor rods are kept in pools onsite — and more is stored there all the time.

Story: Nuclear neighbors: Population rises near US reactors

These mounting risks, though, have not resulted in more vigilant preparations for possible accidents.

The AP found serious weaknesses in plans for evacuations around the plants, including emergency drills that do not move people and fail to test different scenarios involving the weather or the time of day.

Some plans are merely on checklists, and never have been tested. In drills, responders typically go to command centers and not to their emergency posts. There is no federal requirement for how fast an evacuation must be carried out.

And disaster planners from the U.S. Nuclear Regulatory Commission and the Federal Emergency

Management Agency have made dubious assumptions about the public response to a major accident. They insist, for example, that people who are not called upon to evacuate will stay put; they're now saying that they might under some circumstances tell people to hunker down at home even in the 10-mile evacuation zone, and they believe people will do it.

That advice flies in the face of decades of science and policy, millions of dollars in planning and preparations — and common sense.

The advice also conflicts with what U.S. officials told Americans in Japan in March, when an earthquake and tsunami knocked out power to Fukushima and melted fuel in three of its six nuclear reactors.

Japanese officials ordered those living within 12 miles of the site to leave. The U.S. government's advice to its citizens? If you're within 50 miles, you should evacuate. And NRC Chairman Gregory Jaczko insisted that this was nothing more than what would be recommended in a similar situation at home.

Interactive: Aging nuclear plants (on this page)

In fact, under rules in force for more than 30 years, U.S. communities must by law prepare federally reviewed evacuation plans only for those living within 10 miles of a plant. In a severe accident, most of the early deaths — those from radiation sickness, not cancer — are predicted to occur within a 10-mile radius.

Those living within 50 miles, meanwhile, are covered only by an "emergency ingestion zone," where states are required to make plans to ban contaminated food and water — but not evacuate.

After a May 10 tour at the Indian Point nuclear complex, where two reactors operate just 25 miles from New York City's northern border, Jaczko said the 10-mile rule was merely a "planning standard." He said decisions on what to do in the "unlikely event" of an accident would be based on circumstances. "So if we needed to take action beyond 10 miles, that's certainly what would be recommended."

If a 50-mile order were ever issued for Indian Point, it would take in about 17.3 million people — 6 percent of all Americans, according to an AP population analysis. That would include parts of New Jersey and Connecticut and all of New York City, except for a chunk of Staten Island.

Such a mass exodus would be an "enormous challenge" — and a historic feat, said Kelly McKinney, New York City's deputy commissioner of preparedness.

"At no time in the history of man," he said, "has anyone tried to move 17 million people in 48 hours."

Analysis pinpoints growth

When reactors were being built, starting in the 1960s, they were generally kept away from population centers. Their remote locations were viewed as a fundamental safety feature — protection aimed at "reducing potential doses and property damage in the event of a severe accident," according to federal guidelines.

However, over the decades, millions of newcomers have transformed tranquil woodland or shoreline into buzzing suburbs and bedroom communities.

The AP gathered four sets of population data starting in 1980 through 2010 and used mapping software to calculate growth as part of a yearlong investigation of aging issues at nuclear power plants.

Last week, the AP reported that federal regulators, working in concert with industry, have repeatedly weakened or failed to enforce safety standards so old reactors can keep operating. The records review included tens of thousands of pages of government and industry studies, test results, inspection reports and regulatory policy statements.

Map: Nuclear blackout (on this page)

The AP found in its population analysis that over the decades, plant operators and federal regulators have given surprisingly little thought to nearby population growth.

Officials calculate plant safety margins without considering whether an accident would expose 10,000 or 100,000 people to radiation sickness and cancer. And federal regulators have set no limit for how long evacuations may take for given conditions and locations.

The NRC and FEMA acknowledge that radiation releases can happen within a half hour of an accident. Yet a 2004 study for Indian Point estimated total evacuation time from the 10-mile zone, in the snow that is common during local winters, would take 12 hours.

The federal government has not even required population updates for the evacuation zones, though that would change under a proposal expected to be adopted later this year.

The AP analysis also shows that:

- Four million people now live within 10 miles of the 65 operating sites. (Population in overlapping zones was counted only once for this part of the analysis.) Back in 1980, with 38 nuclear sites, only 1.5 million people lived that close.
- Overall, from 1980 to 2010, the average population in the 10-mile evacuation zones ballooned by 62 percent, from 39,762 to 64,363.
- Populations within the 10-mile radius have more than doubled at 12 of the 65 sites during the same 30-year period.
- The most explosive growth occurred around the two-reactor Saint Lucie complex near Fort Pierce, Fla., where the 10-mile population of 43,332 in 1980 grew 366 percent to 202,010 in 2010. Others in the top five: the two-unit Brunswick complex near the North Carolina coast, which increased 326 percent from 8,164 to 34,782; Monticello, 35 miles from Minneapolis, where population rose 314 percent from 14,130 to 58,538; the two-unit Turkey Point site, 20 miles south of Miami, up 302 percent; and the two-unit San Onofre facility in San Clemente, Calif., up 283 percent.
- Among newer reactors, the biggest jump occurred around Shearon Harris, 20 miles southwest of Raleigh, N.C., where population nearly quadrupled from 24,700 in 1990 to 94,465 in 2010. Three other facilities where populations more than doubled during the

same 20-year period are the three-unit Palo Verde site, 50 miles west of Phoenix; two-unit McGuire site, 17 miles north of Charlotte, N.C., and the two-unit Catawba complex in South Carolina, 18 miles south of Charlotte.

❿ About 120 million people, almost 40 percent of all Americans, live within 50 miles of a nuclear plant, according to the AP's analysis of 2010 Census data.

Traffic jams on a good day

The geography and population around Indian Point have always been a challenge for emergency planners.

Homes and businesses dot hillsides sloping to the eastern shore of the Hudson River. Along its bank, a curvy, two-lane main artery meanders past traffic lights through quaint town centers suffused with Dutch history and the lore of writer Washington Irving. At rush hour, the roadway crawls with idling cars.

Choke points are everywhere: the narrow Bear Mountain Bridge just north of the plant; the Route 202 slog through old Peekskill; and the Tappan Zee Bridge, which acts as the major river crossing to the south, beyond the 10-mile evacuation zone.

A potential destination for many evacuees, the bridge often backs up with traffic for miles during the morning and evening commutes.

Just a mile to the west across the Hudson, two-lane Route 9W snakes beneath the base of Bear Mountain State Park, offering few escape routes.

Though modest population growth of 32 percent within 10 miles of Indian Point has mirrored the nation's increase as a whole between 1980 and 2010, more people live within this evacuation zone than any other in the country: 268,906, according to the AP analysis.

Population density isn't the only concern. A 2008 Columbia University study discovered a seismic fault line near Indian Point, where another earthquake-prone zone was already known to exist. Yet a steel liner designed to be earthquake-proof has been leaking at the site since 1973.

New York state has fought relicensing. Gov. Andrew Cuomo says the area can't be evacuated in a severe nuclear accident.

Given the local topography — natural and man-made — a quick evacuation would be a challenge.

But when Jaczko's talk of a possible 50-mile evacuation in the United States is brought into the equation, the prospect is truly daunting.

In some accidents, New Yorkers would presumably head west to New Jersey using the George Washington Bridge, the Lincoln Tunnel and the Holland Tunnel — passageways that are rarely light on traffic. Any evacuation from the 10-mile zone along those routes could be complicated by a so-called shadow evacuation by those living within 50 miles who defy official instructions to stay put.

There are other fears — that some police and bus drivers would leave instead of stay to help and

that parents would rush to schools instead of meeting their children at designated centers outside the evacuation zone.

As with other nuclear sites, the Indian Point emergency plan puts school reception centers outside the 10-mile zone — but not far outside.

Indian Point's lead community evacuation planner, Anthony Sutton, at the Westchester County Department of Emergency Services, acknowledged that area roads couldn't handle the traffic surge from a full-scale nuclear emergency. "I think in a perfect world, we'd all like to see the place in a different location, with all the challenges of evacuating the public around it," he said.

Paul Blanch, a nuclear safety expert who used to consult at Indian Point but now opposes its effort for a 20-year license extension, was more blunt: "No matter what they say, they're not going to be able to evacuate these areas."

John Curry, Indian Point's emergency director, said he believes people can evacuate from the 10-mile zone. But he acknowledges the depth of public skepticism: "It's very difficult, and I don't know how to make them feel any better."

Safety in 'low' numbers

Two dozen of the nuclear sites along the East Coast are within 50 miles of New York, Boston, Washington, Baltimore or Richmond, Va.

"Anyone who lives on the East Coast knows population has grown up around these reactors, and there are certain places where they should never have been built in the first place," said Jim Riccio, nuclear policy analyst for environmental group Greenpeace.

For the most part, though, the early sites were favored if they satisfied the criterion of "remoteness from heavily populated areas," according to the NRC's predecessor, the Atomic Energy Commission.

In 1998, federal guidelines said low-population areas were "generally preferred" because they limit exposure to radiation accidents. This was viewed as part of the NRC's philosophy of multiple layers of accident safeguards. NRC regulations continue to require "low population zones" around prospective nuclear sites.

But from the beginning, it was hard to use very remote sites. Sites were desirable when they were still close enough to transportation networks to haul in massive equipment and supplies and near enough to amenities to lure engineers and corporate managers.

The contradiction meant choosing places like the piney hills of Wake County, N.C., where federal regulators gave permission to build Shearon Harris in 1978.

They described the region as a "sparely populated rural area." But it was just 20 miles from Raleigh — and future commuter sprawl — which accounted for the population nearly quadrupling within the 10-mile zone from 1990 (three years after it went online) to 2010.

Complicating things nationwide, government and industry officials also tended to underestimate projected growth — picking numbers that helped win approval for favored sites.

For example, federal regulators predicted in 1973 that the 50-mile population around the Crystal River nuclear plant in Florida would expand from 155,900 to only 381,000 by 2020. "The basic rural character of the area is not expected to change in the coming 40 years," the government predicted.

Yet the plant was built in Citrus County on the state's picture-postcard west coast, 70 miles north of Tampa. And by 2010 — 10 years ahead of the predicted timetable — the population had already multiplied by six, to over 1 million, the AP analysis shows.

"These population explosions are very likely to make the evacuation plan unworkable," said anti-nuclear activist Paul Gunter at Beyond Nuclear in Takoma Park, Md., who has pressed for reviews of emergency community planning before relicensing.

Even Dana Powers, a member of the NRC's independent Advisory Committee on Reactor Safeguards, says his group "has had troubles with evacuation strategy assumptions."

U.S. Energy Secretary Stephen Chu recently suggested that the Japanese accident will indeed drive U.S. regulators to pick less populated areas for future nuclear plants.

Emergency readiness was supposed to account for growth and stay up to date. The joint guidance of the NRC and FEMA in 1980 stated that "evacuation time estimates should be updated as local conditions change." In fact, according to AP's review of government records, once plant turbines started humming, little was done to keep planning in step with population increases.

In 2007, then-Commissioner Jaczko acknowledged that some evacuation time estimates had not been updated "in decades."

A proposed rule would require fresh estimated evacuation times with new Census data every 10 years — and after that, with any jumps in population that would increase the time estimate by either 25 percent or 30 minutes.

The proposal also would require an annual update of the population estimate. If adopted as expected, it would be the first overhaul of emergency preparedness rules since 1980.

Given the lack of a required evacuation time, though, any updates might make little difference.

Even with increased concern among federal regulators, challenges remain in the mission to inform the public quickly and accurately.

A FEMA web page entitled "Nuclear Power Plant Emergency," last modified on April 8, states: "Nearly 3 million Americans live within 10 miles of an operating nuclear power plant." That's off by one million people.

Then there is the relatively new and sparsely publicized concession to escalating populations and roads that haven't been upgraded or widened in decades. It's called "sheltering" — if people stay put, maybe they can evacuate later, after the first wave of people has left.

A 2007 Sandia National Laboratories report said excess radiation doses could be reduced if residents simply hunkered down in their homes. However, the report acknowledged that "some

contamination and radiation will enter most shelters."

Then, sending another mixed message that could prompt unofficial evacuations, the report continued: If quick evacuation is possible, leaving is "always the most appropriate recommendation."

Playing with numbers

As part of its investigation, the AP has reported that researchers' numbers and assumptions — along with NRC regulations — have been periodically adjusted to keep the reactors within stated limits for operating safety. Similarly, confronted with evacuation troubles, the NRC has minimized the presumed impact of accidents, allowing plants to stay on the power grid.

The studies date back to the early 1980s, when the NRC wanted more guidance about where to locate nuclear reactors. So the agency decided to assess the potential effects of serious accidents on surrounding communities.

Its 1982 report alarmed Congress. At Indian Point Unit 3, the study predicted 64,000 deaths and $314 billion in damages from a bad accident ($700 billion today, adjusted for inflation).

The public was so shaken that the NRC and industry avoided similar analyses for decades.

Map: Spent nuclear fuel (on this page)

However, in its Indian Point relicensing proposal, owner Entergy Corp. finally reevaluates some of the numbers. The effects of a bad accident are minimized, according to an AP analysis of those numbers: no more than 2,130 cancer deaths and only $117 billion in economic damages.

Plant spokesman Jerry Nappi went even further when pressed. Contrary to the calculations of planners, he said he didn't "believe a scenario like this is credible or perhaps even possible" with all the protections built into the plant. As for a 50-mile evacuation encompassing New York, he said a 10-mile radius "is already a very conservative planning zone."

Nuclear planners gave similar confident reassurances about their tsunami planning in Japan. And the BP emergency plans left out Gulf of Mexico oil spill scenarios that occurred, even though they supposedly couldn't happen.

Meanwhile, the NRC's partner, Sandia National Laboratories, has again been studying the impact of accidents. The work is still under way, but researchers have tentatively concluded that reactor defenses will work way better than believed in the 1980s.

NRC officials say the conclusion stems from decades of additional research and sophisticated computer modeling. But they also wrap their equations in a ribbon of rosy assumptions:

- ❿ Accidents will develop more slowly than thought.
- ❿ Buildings designed to contain radiation leaks will hold.
- ❿ Emergency plans will work.
- ❿ Responders will do their jobs.
- ❿ Ninety percent of those told to stay put will obey.

"The magnitude of possible releases from these accidents is much smaller than originally thought," said NRC spokesman Scott Burnell in a preview of the conclusions expected to take final form by 2012.

Plans lack teeth

The population boom near nuclear sites cries out for stronger evacuation standards, according to safety watchdogs. But little has been done, thus helping ensure the continued operation of the aging reactors.

While keeping evacuation zones the same size at aging plants, regulators often have allowed the units to run at higher power levels. More power means more radioactivity that could be released in an accident.

Since 1977, all the reactors collectively have upgraded their maximum power output 139 times.

In May, the two Point Beach reactors, on the Wisconsin shore of Lake Michigan, were each given permission to increase power levels by 17 percent. Meanwhile, population within 50 miles has grown by 36 percent from 573,050 to 779,140 over the past three decades.

In 2008, the NRC's policymaking commissioners even voted to give lower-level staff the authority to approve sensitive changes that would weaken emergency plans. It had been in the purview of the commission itself.

Today, government regulators verify emergency preparedness of communities essentially by checklists, not by standards for what plans must accomplish. They require that communities show the elements of a good plan, but not that the plan is effective.

For example, evacuation time estimates are required, but there is no standard for how quickly people must be able to leave. Regulators say the estimates will help planners make decisions in a real accident, even in the absence of a standard.

Jim Kish, a FEMA administrator who focuses on emergency preparedness, said in an interview that a standard would put communities in an undesirable "planning box."

"They need the flexibility to make decisions on what to evacuate, and when to evacuate, and how to evacuate," he said.

"I think the NRC wants to make sure that the evacuation side of things doesn't make plants have to close, even if the population grows quickly," said Richard Webster, an environmental lawyer who unsuccessfully fought the relicensing petition at the Oyster Creek reactor in Lacey Township, N.J.

More broadly, the government seems careful to avoid anything fully binding in its planning requirements. It sets a supposed standard that people within 10 miles must be notified of an accident within 45 minutes. But NRC rules also say that's not a guarantee early notification can be provided for everyone.

And notification of an accident within 45 minutes says nothing about how long it will take to flee.

NRC rules also concede there's no guarantee that emergency sirens, "when tested under actual field conditions, will meet the design objective in all cases."

This movable standard makes things easier for plant owners who often struggle to keep warning sirens working from their perches within the 10-mile zones.

FEMA encourages drills for rush-hour traffic, night conditions, or bad weather. But it does not require them, the agency acknowledged.

Heather Heigl, the lead community emergency planner for the area around the Brunswick site in North Carolina, said daylong drills every two years verify that the right people and resources are available, and that communications systems are working.

However, she acknowledged, the exercises don't actually send rescue workers to shelters or police officers to traffic control points. Asked for the estimated evacuation times for her site, she wasn't sure.

"The NRC rubber-stamps these evacuation plans, but they're not based on discernible performance standards," said Alex Matthiessen, president of the Riverkeeper environmental group fighting Indian Point relicensing. "If they applied any kind of meaningful standard in evaluating the emergency plans of the nation's nuclear power plants, there would be no nuclear power plants in this country, at least not in populated areas."

Attorney Webster argued that safety standards should become harder to meet as populations grow around plants like Oyster Creek. (In AP's analysis, population between 1980 and last year increased 269 percent within 10 miles of Oyster Creek, from 36,738 to 135,378.)

During an emergency there, many would be forced to leave in the same direction, away from the Atlantic Ocean, along a highway that a pro-nuclear state senator has called "a two-lane cow path."

Janet Tauro, a nuclear safety activist who lives 18 miles from the plant, wonders: "Picture me with my son on his BMX bike and my daughter at dance class, multiply me by 100,000 — and you have pandemonium."

Helen Henderson, who lives three miles from the reactor, is among the doubters. She said she repeatedly ignored the forms sent home by her children's school certifying that she has read and agrees with the Oyster Creek emergency plan.

Tired of the stream of reminders sent her way, Henderson said she finally wrote back: "Refuse to sign. Evacuation plan will not work."

Saprodani Associates

177 US Hwy 1N, Unit 212, Tequesta, Florida 33469
Phone:1-561-972-8363 Email:saprodani@gmail.com

AP Aging Nukes (Part-4)

By JEFF DONN
Associated Press

updated 6/28/2011 12:03:23 AM ET

Editor's note: Links to the first three parts of this four-part series are at the end of this report.

ROCKVILLE, Md. — When commercial nuclear power was getting its start in the 1960s and 1970s, industry and regulators stated unequivocally that reactors were designed only to operate for 40 years. Now they tell another story — insisting that the units were built with no inherent life span, and can run for up to a century, an Associated Press investigation shows.

By rewriting history, plant owners are making it easier to extend the lives of dozens of reactors in a relicensing process that resembles nothing more than an elaborate rubber stamp.

As part of a yearlong investigation of aging issues at the nation's nuclear power plants, the AP found that the relicensing process often lacks fully independent safety reviews. Records show that paperwork of the U.S. Nuclear Regulatory Commission sometimes matches word-for-word the language used in a plant operator's application.

Also, the relicensing process relies heavily on such paperwork, with very little onsite inspection and verification. And under relicensing rules, tighter standards are not required to compensate for decades of wear and tear.

So far, 66 of 104 reactors have been granted license renewals. Most of the 20-year extensions have been granted with scant public attention. And the NRC has yet to reject a single application to extend an original license. The process has been so routine that many in the industry are already planning for additional license extensions, which could push the plants to operate for 80 years, and then 100.

Story: Senator calls for probe of nuke evacuation plans

Regulators and industry now contend that the 40-year limit was chosen for economic reasons and to satisfy antitrust concerns, not for safety issues. They contend that a nuclear plant has no technical limit on its life.

But an AP review of historical records, along with interviews with engineers who helped develop nuclear power, shows just the opposite: Reactors were made to last only 40 years. Period.

The record also shows that a design limitation on operating life was an accepted truism.

In 1982, D. Clark Gibbs, chairman of the licensing and safety committee of an early industry group, wrote to the NRC that "most nuclear power plants, including those operating, under construction or planned for the future, are designed for a duty cycle which corresponds to a 40-year life."

And three years later, when Illinois Power Co. sought a license for its Clinton station, utility official D.W. Wilson told the NRC on behalf of his company's nuclear licensing department that

"all safety margins were established with the understanding of the limitations that are imposed by a 40-year design life."

Some early advocates even believed that technological advances would enable the industry to replace those first models sooner.

Interactive: Aging nuclear plants (on this page)

When he was a member of the Joint Committee on Atomic Energy in the late 1960s, U.S. Rep. Craig Hosmer declared that "power companies expect nuclear generating stations to last 30 years."

Nuclear physicist Ralph Lapp, an advocate of atomic power, predicted a 25-year life span.

One person who should know the real story is engineering professor Richard T. Lahey Jr., at Rensselaer Polytechnic Institute in Troy, N.Y. Lahey once served in the nuclear Navy. Later, in the early 1970s, he helped design reactors for General Electric Co.; he oversaw safety research and development.

Lahey dismisses claims that reactors were made with no particular life span. "These reactors were really designed for a certain lifetime," he said. "What they're saying is really a fabrication."

And nuclear engineer Bill Corcoran, who worked for plant designer Combustion Engineering, said certain features were specifically created with 40 years in mind, like the reactor vessel, which holds the radioactive fuel. He said metals were calculated to hold up against fatigue for that long. Concrete containment buildings had to be strong enough to last that long.

No one analyzed if they could last much longer.

Nuclear life renewed

It's easy to forget that the nuclear industry looked as if it might be dying off in the late 1990s.

In 1999 and 2000, several nuclear plants sold for astounding fire-sale prices of less than $25 million each, according to trade group data obtained by the AP. The country's oldest, Oyster Creek near the New Jersey shore, went for $10 million — a paltry fraction of its $65 million construction cost in dollars adjusted for inflation.

But that was before relicensing, which changed everything.

Story: Nebraska nuclear plants safe despite flooding, official says

Relicensing is a lucrative deal for operators. By the end of their original licenses, reactors are largely paid for. When they're operating, they're producing profits. They generate a fifth of the country's electricity.

New ones would each cost billions of dollars and take many years for approval, construction and testing. Local opposition may be strong. Already there is controversy about the safety of a next-generation design. Even before the nuclear crisis at the Fukushima Dai-ichi complex in Japan, only a handful of proposed new reactors in the U.S. had taken the first steps toward construction.

Solar and wind power are projected to make very limited contributions as electrical demand rises about 30 percent by 2035. So keeping old plants operating makes good business sense.

But some watchdogs suggest the equation isn't that simple.

"The plants aren't any safer because they're needed, and they certainly aren't any safer because someone says they're needed. So that's the wrong way to regulate," said Peter Bradford, a former NRC commissioner who now sits on the board of the activist Union of Concerned Scientists.

It's challenging to keep existing plants safe and up to date.

The NRC has indicated that safety improvements are likely in the aftermath of melted fuel in the Japanese reactors in March. NRC inspectors have found some problems with U.S. equipment and procedures. But the agency says all sites are ready to deal with earthquakes and flooding. The NRC also has formed a task force to investigate further and report back in July. Both the task force and the NRC chairman have already suggested that changes will be needed.

Story: Beyond Japan's Fukushima exclusion zone, shuttered shops speak to radiation doubts

Meanwhile, license renewals, which began in 2000, continue. The process essentially requires a government-approved plan to manage wear. These plans entail more inspection, testing and maintenance by the operator, but only of certain equipment viewed as subject to deterioration over time.

The plans focus on large systems like reactor vessels. It is assumed that existing maintenance is good enough to keep critical smaller parts — cables, controls, pumps, motors — in good working order for decades more.

Some modernization has been put in place — upgrades on fire-prevention measures and electronic controls, for example. But many potential improvements are limited by the government's so-called "backfit rule." The provision exempts existing units from safety improvements unless such upgrades bring "a substantial increase" in public protection.

Even with required maintenance, aging problems keep popping up.

During its Aging Nukes investigation, the AP conducted scores of interviews and analyzed thousands of pages of industry and government records, reports and data. The documents show that for decades compromises have been made repeatedly in safety margins, regulations and emergency planning to keep the aging units operating within the rules. The AP has reported that nuclear plants have sustained repeated equipment failures, leading critics to fear that the U.S. industry is one failure away from a disaster.

Industry, government as partners

Despite the aging problems, relicensing rules prohibits any overall safety review of the entire operation. More conservative safety margins are not required in anticipation of higher failure rates in old plants, regulators acknowledge.

The approach has turned relicensing reviews into routine approvals.

"Everything I've seen is rubber-stamped," said Joe Hopenfeld, an engineer who worked on aging-related issues at the NRC before retiring in 2008. He has since worked for groups challenging relicensing.

Numerous reports from the NRC's Office of Inspector General offer disturbing corroboration of his view.

For example, in 2002 the inspector general wrote: "Senior NRC officials confirmed that the agency is highly reliant on information from licensee risk assessments." Essentially that means the industry tells the NRC how likely an accident is and the NRC accepts the analysis.

Five years later, in a relicensing audit, the inspector general complained of frequent instances of "identical or nearly identical word-for-word repetition" of the plant applications in NRC reviews. The inspector general worried that the repetition indicated superficial reviews that went through the motions, instead of thorough and independent examinations.

In one instance, both the renewal application for Millstone Unit 2 in Waterford, Conn., and the supposedly independent NRC review described corrosion control with identical language.

From the Millstone application: "The number of planned and unplanned replacements has generally trended downward over the past several years due to the establishment of the Flow-Accelerated Corrosion program and following the recommendations identified in NSAC-202L."

From the NRC review: "The project team reviewed operating experience for the applicant's Flow-Accelerated Corrosion program. The number of planned and unplanned replacements has generally trended downward over the past several years due to the establishment of the Flow-Accelerated Corrosion program and following the recommendations identified in NSAC-202L."

Both reactors at the site were given license extensions in 2005.

The problems went beyond paperwork. The inspector general found that the NRC reviews usually relied on the plants to report on their operating experience, but the agency didn't independently verify the information.

NRC spokesman Eliot Brenner said staffers have now agreed to use their own words in their reviews of relicensing applications.

But the inspector general has not re-audited the process since. And Jerry Nappi, a spokesman for the Indian Point reactors 25 miles north of New York City, still describes it as a "collegial process."

It is a process that was shaped in the late 1990s by Christopher Grimes, who was then director of license renewal for the NRC. More recently, he has worked with local Indians to challenge parts of the license renewal request for the Prairie Island nuclear plant in Minnesota.

Map: Spent nuclear fuel (on this page)

Grimes acknowledges that the NRC "has to rely much more on the contents of the applications ... over direct inspection."

He blames budget constraints, but others view relicensing as a charade. Clean Ocean Action unsuccessfully challenged relicensing at Oyster Creek in New Jersey, but chief scientist Jennifer Sampson said, "We really knew it was a waste of time."

Adds Janet Tauro, another activist who fought the Oyster Creek relicensing: "Relicensing is designed for relicensing to happen. They've got all the plants on a conveyor belt, and they don't want anything slowing it down."

From 40 years to 60, and beyond

There are two thrusts to the revisionist argument that nuclear reactors can last for decades and decades: First, that they weren't really designed only for 40 years; second, that there is no technical limitation on any length of time. In theory, they could run forever.

Tony Pietrangelo, chief nuclear officer at the industry's Nuclear Energy Institute, says 40 years for the initial license was simply how long it was expected to take to pay off construction loans.

In 2007, as Entergy Nuclear Operations sought a license extension for the Pilgrim reactor in Massachusetts, it wrote: "The original 40-year license term was selected on the basis of economic and antitrust considerations rather than on technical limitations."

Yet writers seemingly contradicted themselves in the same document: "During the design phase for a plant, assumptions concerning plant operating durations are incorporated into design calculations for plant systems, structures, and components."

The next year, an NRC report was more emphatic about the economic rationale of 40-year license, insisting that "this time limit was developed from utility antitrust concerns and not physically based design limitations from engineering analysis, components, or materials."

Even so, it too felt compelled to acknowledge, in passing, that "some individual plant and equipment designs" were engineered for 40 years of life.

What's the truth? Fifty years ago, rural electricity cooperatives, worried about competition, did object to granting indefinitely long licenses to the new nuclear industry. But that's only part of the story.

The 40-year license was created by Congress as a somewhat arbitrary political compromise — "some long period of time, because nobody in his right mind would want to operate a nuclear plant beyond that time,'" said Ivan Selin, an engineer who chaired the NRC in the early 1990s.

Instead of stopping at 40 years, or even 60, the industry began advancing the idea of even longer nuclear life in discussions with its NRC partners starting several years ago.

One of the first clear signs of their intentions emerged in 2008 with an NRC-industry workshop on nuclear life beyond 60 years. Its summary said that "participants did not believe there is any compelling policy, regulatory, technical or industry issue precluding future extended plant operations."

The next year, an issue paper by the industry-funded Electric Power Research Institute said that "many experts believe ... that these plants can operate safely well beyond their initial or extended

operating periods — possibly to 80 or 100 years."

In November, an EPRI survey of industry executives found that more than 60 percent of executives strongly believed reactors can last at least 80 years.

EPRI engineer Neil Wilmshurst said in an interview that many in the industry foresee the feasibility of reactors lasting even longer.

Adding its own push, Congress has set aside $12 million over the past two fiscal years for the Department of Energy to study if nuclear plants can last decades longer.

So for industry, the question is not if plants can run decades longer — that is now presumed true — but for how long?

"The research must start now, as it will take years to gather the data necessary to justify life extension out to 80 or 100 years," EPRI says in a background document.

Maria Korsnick, senior vice president of Constellation Energy Nuclear Group, indicated that her company may start applying for a second license extension within 10 years. Constellation owns two of the country's oldest reactors, Nine Mile Point and Ginna in upstate New York. It also owns Calvert Cliffs in Lusby, Md., which acquired the industry's first renewed license in March 2000.

"My challenge is that if you go ahead and let these current operating units retire, you're going to end up with a gap before you're going to have sufficiently been able to build the new nuclear plants to take their place," Korsnick said. "Why put myself in that crisis?"

How long can they go?

Reactors and their surrounding equipment obviously were not made to fall apart the day after their 40th birthday. But how long can they safely last?

Other power generators have recognized the limits of design life. Though plants burning coal and other traditional fuels incorporate many similar systems to nuclear units — minus the atomic reactor — 90 percent close within 50 years, according to Department of Energy data analyzed by the AP.

Dana Powers, a member of the NRC's independent Advisory Committee on Reactor Safeguards, said he believes nuclear plants can last for just one license extension, or up to 60 years total. "I doubt they go two," he added.

Map: Nuclear blackout (on this page)

Peter Lyons, a physicist and recent NRC commissioner, said several features of plants are extraordinarily hard to replace and could limit their lifetimes. They include reactor vessels, electric cables set in concrete, and underground piping.

And Brian Wirth, an engineer at the University of California, Berkeley, who studies how radiation makes metal prone to breaking, said the industry may not even have the ability to check for possible damage to reactor vessels for an 80-year life span.

In an AP interview at NRC headquarters here, agency chairman Gregory Jaczko said decisions on license extensions are based on safety, not economics.

Former NRC chief Selin says extension decisions should be made "on a case-by-case basis."

And industry executives and regulators acknowledge that more research is needed.

In the past, though, both parties found ways to shift assumptions, theories and standards enough to keep reactors chugging.

There's every reason to think they'll try to do it again.