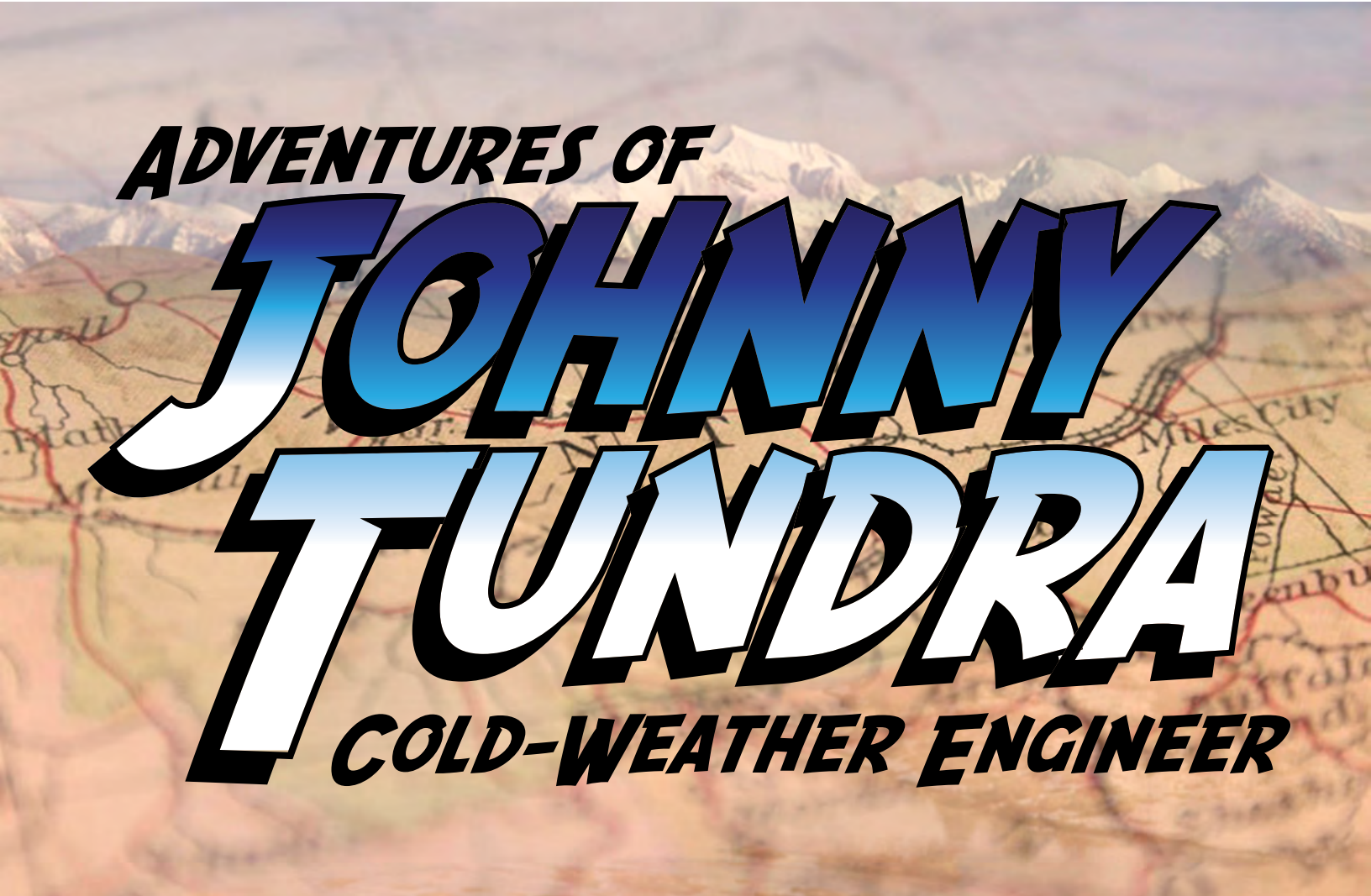


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*ADVENTURES OF*  
**JOHNNY**  
**TUNDRA**  
*COLD-WEATHER ENGINEER*

**THE RETURN OF JOHNNY TUNDRA, COLD-WEATHER ENGINEER**

Author Ron Wilkinson wanted to call attention to cold-weather problems in a way "that was fun and that described the American 'can-do' attitude in the context of actual engineering problems." **The result: Johnny Tundra.**

Written by Ron Wilkinson, PE, LEED AP, CMPI  
Illustrations by Ashley Riblett

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# ADVENTURES OF **JOHNNY TUNDRA** COLD-WEATHER ENGINEER

In May 2015, HPAC Engineering magazine launched a new series online and in print that would prove to be one of our most popular and enduring features: **The Adventures of Johnny Tundra: Cold-Weather Engineer**. Ultimately, the engaging, 13-part series about a fictional engineering hero in Montana (and his faithful dog) would run for more than two and a half years, before concluding last December with a generational handoff to a younger, tech-savvy trouble-shooter representative of a new era for engineers. Here, for the first time, is the complete collection of all of the Johnny Tundra adventures. Sit back, pop some popcorn, and enjoy!

— Rob McManamy  
Executive Editor, HPAC Engineering

## **THE SAGA OF JOHNNY TUNDRA, COLD-WEATHER ENGINEER**

In 2000, Ron Wilkinson was working as chief engineer for the Architecture & Engineering Division of the State of Montana. His job took him to the far corners of Big Sky Country, where he was exposed to many odd engineering problems related to—not surprisingly—cold weather.

“At the time, our state claimed the record cold temperature in the contiguous 48 states,” Ron recently recalled. “When it gets 70 degrees below zero, strange things happen.”

This marked the beginning of Ron’s experience as a commissioning authority. At the time, most commissioning case studies focused on problems of moisture incursion in air-conditioned buildings in hot and humid climates. Ron wanted to call attention to cold-weather problems in Montana and other Northern Tier states.

“I had done—and still do—a lot of conventional articles, papers, and conference sessions,” Ron said. “I wanted to do something that was fun and that described the American ‘can-do’ attitude in the context of actual engineering problems.”

Drawing on his experiences traversing The Treasure State, Ron set out writing a series of mystery/adventure stories starring the “troubleshooter from Big Timber,” Johnny Tundra, Cold-Weather Engineer.

A combination of John Wayne and fictional detective Hercule Poirot, Johnny is “calm, cool, and irreversibly logical,” Ron said. He travels the Montana countryside,

his 15-year-old Basset Hound, Gas Train, by his side, in a 1972 International Harvester Scout. It may not be the most stylish of rides, but Johnny doesn’t care.

“His work is everything,” Ron explained, “but his own home remodel jobs are perpetually unfinished because he drops everything to go to the next emergency.”

Johnny “amazes those around him as he saves their bacon” and “knocks himself out with a new lesson learned every day,” but he is no superhero, Ron said.

“Although Johnny may seem to be a genius, he never solves anything that his friends could not solve for themselves eventually,” Ron said. “He just cuts through the fretting and worry and sees the problem—and solution—as clear as day.”

The key for Johnny is that he “approaches engineering as applied innate curiosity, rather than a profit-making business model,” Ron said. “He is an incompetent politician and marginal businessperson, and this empowers him to concentrate on the simple wonder of how things work, rather than simply saying the right things to make people happy. He likes to approach technical problems as detective stories, pulling bits and pieces of the picture together until the solution appears before his eyes.”

The aim of the stories, Ron said, “is to emphasize the beauty, simplicity, and wonder of natural science as applied to MEP engineering. The world is, indeed, a series of science problems waiting to be solved; the more pure the motive, the more ready the answer.”

# DON'T SHOOT THE BOILER

Despite a new roof, new attic insulation, and a new boiler, energy consumption at Fish & Wildlife Region 9 headquarters has skyrocketed. Facility Manager Virgil "Eggshell" Coggeshell is about to crack. Luckily for him, his old pal Johnny Tundra is there to pick up the pieces.

MAY 2015



Johnny was headed home after finishing his latest commissioning project in Miles City. It was a long drive to his Big Timber bungalow. The flat prairie highway stretched out ahead, packed white with snow and ice and flanked on both sides by frozen and forbidding mesas. The setting sun poked over the Crazy Mountains to the west and shed a frosty stream of light through the frigid December air. The cab of the International Harvester Scout was warm despite the outdoor-air temperature hovering around zero.

As usual, Johnny was traveling with Gas Train, his 15-year-old Bassett Hound. Needing a break in the middle of the drive home, Johnny stopped at Fish & Wildlife Region 9 headquarters for a cup of coffee with his old pal Virgil "Eggshell" Coggeshell. The nickname Eggshell alluded to Virgil's bald pate. Virgil had his own nickname for Johnny: "Hard Luck," in reference to Johnny's failure to fill his deer tag six seasons in a row.



The Fish & Wildlife headquarters had been remodeled the previous summer and now boasted a third floor. Johnny checked out the new structure as he maneuvered the Scout between snow drifts. The whole building had been repainted, and the new synthetic-tile roof looked spic and span in the bright afternoon sun.

"Hey, Egg, how's it goin'?" Johnny yelled out the window, echoed by an enthusiastic, if bewildered, bark from Gas Train.

"Just peachy, Hard Luck!" Virgil called back. "I got a completely new roof, all new attic insulation, and a new boiler, and my natural-gas bills have doubled so far this winter! The boss is about ready to have a stroke! We expected a little more energy use due to the new third floor, but we also expected the new insulation and boiler to cancel that out. Instead, our consumption skyrocketed!"

"The boiler vendor's been down here three times in the last three months and swears the boiler's working fine," Virgil continued. "I told him if he didn't figure out what was going wrong, I was goin' to use him for target practice come next hunting season! Course, if you used him for target practice, he wouldn't have to worry much. Ha, ha!"

Virgil still was chortling over his joke as Johnny slid out of the Scout onto the compact snow of the parking area.

"Very funny," Johnny said, "but if you can steer me to a cup of joe, I might just eyeball your boilers and see what's cooking, if anything."



As they walked to the boiler room, Virgil told Johnny about the remodeling project. While the third floor was being added, several energy-conservation measures were implemented. For starters, the old oil-fired steam boiler was replaced

with four modular gas-fired hydronic (hot water/glycol) units. The existing steam and condensate lines were checked for scale and found to be serviceable. The old steam line was large enough to serve as the supply for the new hydronic system, but the condensate line was too small, so a new hydronic return line was installed in the existing pipe chase from the boiler room to the third floor.

The existing domestic-hot-water line in the chase was found to be leaking badly, but was inaccessible for repair. So, after a good cleaning, the old condensate line was used as the new domestic-water line. A new heat exchanger was added to the boiler system to heat the domestic water.

Reusing the old pipe chase took some ingenuity, as it was bricked into the center of the building. The contractor continued the chase up to the third floor and installed the new pipes that were required.

Entering the boiler room, Johnny gave the boilers and piping a quick once-over.

"Best boilers in the business," Virgil said. "Built from the ground up to save energy. But they ain't saving any energy here!"

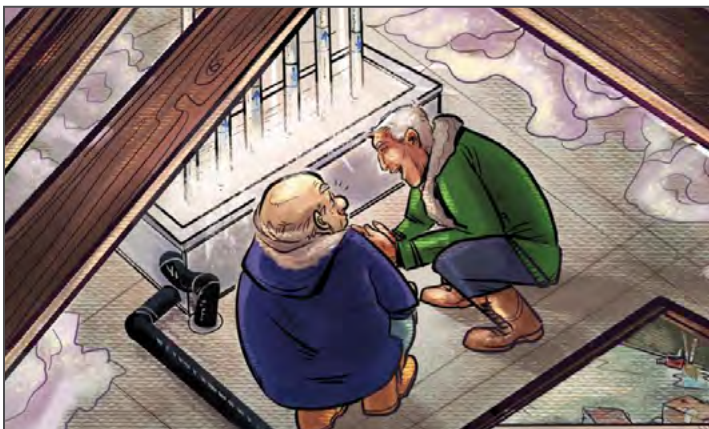
Johnny walked over to the new domestic-water heat exchanger and glanced at the old brick entrance to the pipe chase. He put his hand on the domestic-hot-water circulation pump.

"Run the circ pump all the time, do you?" Johnny asked as he waved his hand in front of the opening to the chase.

"Sure," Virgil answered. "It uses so little power, it costs more to put a timer on it than it's worth. Believe me, electricity isn't the problem here. Our electricity bill came down just fine when we pulled out that old electric water tank. It's these blasted boilers that are eating me alive!"

"Egg, is there an access hatch to the attic above that new third floor?" Johnny asked. "Your energy problem ain't in your boilers; it's in your pipe chase!"

"Johnny, this time, you've truly lost your marbles," Virgil impatiently replied. "But if it's the attic you want, it's the attic you'll get."



Johnny and Virgil climbed the stairs to the third floor. Virgil opened the janitor's closet and pointed to the ladder to the attic. The two climbed up and squatted on a plywood platform above a sea of insulation over the third-floor ceiling. Johnny could see the last fading light of the afternoon coming in through the soffit vents. He and Virgil waddled over to the top of the pipe chase.

"Look down there, and tell me what you see," Johnny said.

Virgil peered down the chase. "I see a light," he said. "How did that get there?"

"That's my flashlight," Johnny said. "I put it at the bottom of the chase. You're looking straight down three floors to the boiler room. Feel that draft?"

"Boy, I'll say!" Virgil exclaimed. "How did you make that wind tunnel?"

"I didn't make anything," Johnny said. "That wind tunnel has been here ever since last summer. When your contractor added the third floor, he removed the cover over the old chase and extended it up to this level. Unfortunately, he neglected to put on a new cover when he finished up.

"But the frosting on the cake is that old condensate pipe down there," Johnny continued. "The contractor had to extend it up, too. And he insulated the new portion, just like the specs said. But the old portion was never insulated. The original building designer figured energy was cheap and what little heat was left in the condensate line would heat the building anyway, so it was left bare during the original construction. When the pipe was extended, the contractor had no access to insulate the old pipe. Since the specs didn't call for it to be insulated, he left it as is.

"So, what you have now is a 20-foot length of uninsulated pipe that is kept hot 24 hours a day by your domestic-hot-water heat exchanger and circ pump," Johnny added. "Even worse, you have a 30-foot chimney of heated air that is sucking the hot air out of your building and exhausting it to this vented attic space, where it quickly dissipates to the outdoors. You couldn't have designed a better hot-air exhaust system if you tried.

"I knew something was wrong when I drove into the parking lot and saw the snow had melted off the new roof," Johnny concluded. "You're trying to heat the entire eastern half of Montana. If you seal the top and bottom of this chase and put that circulation pump on an eight-hour-a-day, five-day-a-week schedule, I bet you'll see those energy savings come back."

"As much as I hate to say it, Hard Luck, it looks like you hit the bull's eye again," Virgil sighed with relief. "Even if it is the first time since the start of hunting season!"

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## RX FOR A FEVERISH DRUG-STORAGE ROOM

At Stony End Home for the Aged, facilities manager Thatcher “Thatch” McGowan is feeling the heat—in more ways than one. The colder it gets outside, the warmer it seems to get in the pharmaceutical storage room. If drugs have to be destroyed for being stored out of compliance, the superintendent vows to use Thatch’s carcass to test the incinerator! Luckily for Thatch, his pal Johnny Tundra is making the rounds.

JUNE 2015



**W**inter had come early to central Montana. Though it was only mid-November, the peaks of the Judith Mountains to the west already were capped with snow. The wind kicked up vaporous wisps of powder in the crisp morning air.

Johnny Tundra was on his way home from a boiler tune-up at Freeman Trauma Center in Jordan when he decided to pay a visit to old friend Thatcher “Thatch” McGowan, the facilities manager at Stony End Home for the Aged. Johnny took the Angela exit off Highway 59, swerving to miss a grazing deer. Unfortunately, the swerve caused a shift in the capacious jowls of Johnny’s loyal traveling companion, 15-year-old basset hound Gas Train, causing him to topple off the seat and onto the floorboard.

Gas Train still was howling with dismay when Johnny pulled up to the Stony End loading dock, next to a delivery van. Thatch (so named for the last growth of sage brush on his head) was rushing about, giving directions to the deliveryman, who had boxes of dry ice loaded on a lift truck.

“Through the shop, down the hall, around the corner, and into the room marked ‘Supply,’” the harried facility manager told the deliveryman. “And make it quick! And shut the door behind you! ... Oh, hi, Johnny! What’s up?”

“Nothing much, Thatch,” Johnny replied. “I just thought I’d stop by and say hi. What’s with the dry ice? Is 10°F not cold enough for you?”

“It’s plenty cold enough for me,” Thatch answered, “but I’ve got a pharmaceutical storage room in here that has to be below 65°F, and I can’t seem to get it there. It seems like the colder it gets outside, the warmer it gets in the storage room. There’s something wrong with the BAS controls that keeps telling the unit ventilator to heat the space when there’s no call for heating.

“I can lock the heating off at the BAS, but still feel the warm air coming out of

the unit,” Thatch continued. “I’ll probably have to call in the factory technician from Wounded Bear, Wyo., and you know what that will cost. The superintendent isn’t going to like it. But he told me if we have to destroy those drugs because they were stored out of compliance, he’d use my carcass to test the incinerator!”



“Now hold on a minute,” Johnny said. “You just replaced that chiller last summer, and it was working fine. How can you have a cooling problem now?”

“It has nothing to do with the chiller,” Thatch said. “The chiller is locked out at any temperature below 35°F, and it hasn’t been above that in weeks. The 55°F supply air to the unit ventilators is cool enough to maintain the room temperature. If the BAS wasn’t telling the unit ventilator to heat the air, it would be coming out at 55°F and cooling the room just fine. But the air is coming out at more like 70°F.”

“Have you checked the supply-air temperature?” Johnny asked. “Could it be the air-handling unit is out of whack and overheating the ventilation air to the unit ventilators?”

“Yeah, I checked that on the BAS and double-checked it with a thermometer in the supply duct,” Thatch replied. “The supply air is right on 55°F. Sometimes, I think those control techs set us up for these problems just to get service calls. I’m going to tell that guy what I think when I see him, too!”

“Now just hold on there, Thatch,” Johnny said. “Don’t get your nose in a twitch until we check out the facts. Let me take a look at that BAS of yours.”

Thatch led Johnny to the maintenance shop, where the BAS operator workstation was located. Johnny sat in front of the display while Thatch guided him to the AHU screen and showed him the indication for supply-air temperature. Sure enough, it was 55°F.

Thatch then guided Johnny to the unit-ventilator screen. Sure enough, the unit ventilator was calling for full cooling and no heating. Next in line was the chiller; its status was “off.”

“We don’t get much information on the chiller from the BAS,” Thatch explained. “The chiller is controlled by its own control panel, and the panel protocol isn’t compatible with the BAS system. So, all we can remotely monitor is status.”



Just then, the phone started ringing. Thatch answered it as Johnny checked out a few more screens.

“McGowan here. ... Yes, sir. ... Don’t you worry, sir. The dry ice will keep the temperature down for a couple of hours, until I can get a technician here. We just have to check a couple of ... Oh, OK. ... Yes, sir. I’ll get a technician here right now. ... Yes, sir.”

Thatch hung up the phone.

“Boy, is he steamed,” Thatch groaned, shaking his head. “He says if that room goes one degree above 65, he swears he’ll have my job—and my hide to boot! I better get that high-priced wrench slinger here on the double.”

“Whoa. Slow down,” Johnny interjected. “This screen says you have one pretty hot machine room—90°F!”

“Well, yes, that’s probably true,” Thatch replied. “We’ve been working on some piping and have some insulation off. So what?”



“Just this: I have a feeling your problem isn’t in your unit ventilator; it’s in your machine room,” Johnny said. “Let’s go take a quick gander before you call that pricey repairman.”

Thatch and Johnny strode down a long corridor to the machine room. Upon

opening the door, Johnny could feel the warm air of the crowded, machine-filled space. He walked up to the chilled-water pumps and glanced at the units, then looked up at the unit heater hanging from the ceiling.

“Funny place for a unit heater,” Johnny observed, “in an overheated machine room.”

“That’s not a heater,” Thatch replied. “It’s a cooler. That coil is connected to the chilled-water circuit. But since the chiller is locked off by the outdoor temperature, it’s not doing any cooling now.”

“That’s the problem,” Johnny said. “It’s cooling—a little. At least it’s cooling enough to heat your drug-storage room.”

“You see that chilled-water pump over there?” Johnny asked. “It’s running. I checked on the BAS and saw that the circulating pump was energized, but I wanted to come here and check it for sure. The pump is running because the BAS turned it on, because the storage room called for cooling.”

“But because of the low outside-air temperature, the chiller is locked off at its own panel,” Johnny continued. “So, the BAS turned the chilled-water pumps on, but the chiller stayed off. As a result, water is circulating through the machine-room cooling coil and heating up the chilled-water loop. When the pharmaceutical-storage-room unit ventilator calls for cooling, all it gets is warm water from the cooling loop. The more the room calls for cooling, the more warm water it gets.”

“All you have to do is throw the disconnect on those chilled-water pumps,” Johnny concluded. “Once they stop, you should see the temperature in the storage room drop to its 60-degree set point and stay there. When you get the time to reprogram the BAS, lock out those chilled-water pumps at the same temperature as the chiller lockout. That way, the pumps won’t run on a call for cooling unless the chiller also is starting up at the same time. If you do that, your chilled-water loop always will be chilled water, not water heated by the machine room.”

“By George, Johnny, you’ve done it again!” Thatch exclaimed. “Thanks to you, it looks like I’ll keep my job—and my hide—after all!”

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# CAPITOL CASE

On the eve of public hearings at the state capitol, Supervisor of Facilities Maintenance and Operations Hank Hoovestahl is facing a grilling worse than that of any witness: If he does not get the chiller serving the meeting rooms in the recently remodeled building running by noon the next day, Senate Majority Leader—and armchair engineer—Lester Heapleach vows to, shall we say, remove him from office. Luckily for Hank, he has the backing of his pal Johnny Tundra.

AUGUST 2015



Johnny Tundra had just pulled off Highway 12, headed into Townsend for a cold one at his favorite watering hole, The Mint, when his cell phone rang.

"This cannot be good," Johnny thought as he retrieved the phone from under the flaccid jowls of his loyal traveling companion, his 15-year-old basset hound, Gas Train.

It was 5:30 p.m. on a Friday. No one but someone facing a skewering if something didn't get fixed fast would call him at 5:30 p.m. on a Friday.

"Tundra here."

It was Johnny's pal Hank Hoovestahl, supervisor of facilities maintenance and operations at the state capitol in Helena.

"Johnny! Boy, am I glad I got ahold of you. I am in a pickle this time, and Lester says he will have me tarred and feathered if I don't get this chiller running by tomorrow noon!"

"Now, just hold on there, Hank," Johnny said, as leverage got the best of Gas Train, who fell—his ample chops first—onto the floorboard of the braking International Harvester Scout. "Lester who? And what's he in a twitch about?"

"Lester Heapleach, the Senate majority leader. He tried to be an engineer once and says if I don't get some cooling into these meeting rooms for the public hearings tomorrow, he'll cook my goose in Boiler No. 2! They just spent \$20 million on this capitol remodel, and they expect it cool as a cucumber in those chambers."

"We've been getting free cooling out of the closed-circuit tower so far this winter, but it's getting warm, and tomorrow's supposed to be a real cooker," Hank continued. "We'll need that chiller for those interior spaces—especially when they are crammed with concerned citizens and confused legislators."

"We've tried to start the chiller a dozen times. It runs for about a minute and then trips out. The factory representative in California is headed this way, but can't get here until tomorrow afternoon. By then, it will be too late. Lester wants to sue!" Hank added.

"OK," Johnny replied. "I was headed to The Mint down here in Townsend, but if you give me a half-hour, I'll come up and eyeball the situation. My bet is we can get you cooled down soon enough."



As Johnny helped Gas Train out of the International Harvester Scout in the parking lot of the capitol building, he could hear the cooling tower deep inside the boiler plant working, confirming the tower was cooling with the chiller offline. As Johnny and Gas Train started toward the plant door, Hank burst out.

"What took you so long?" Hank said, feigning outrage. "You ride that hound of yours? ... Old Gas Train is looking a little worn out these days; better get a retreat on those lips. Ha, ha!"

Turning serious, Hank continued: "Johnny, this chiller's got me up a tree. All I can figure out is that the controller's bad. The factory can fly another one up tomorrow, along with the startup technician, but it'll cost \$15,000 for the rush service. I can't afford to take it out of the maintenance budget, but I'll have to anyway. Come on and take a look."

Hank showed the new chiller, the closed-circuit cooling tower, and the three-way-valve arrangement for the chiller and “strainer cycle” circuits to Johnny. Return chilled water could be routed to the cooling tower, the chiller, or both. During winter, the cooling tower was run with no spray, with the sump drained and spray pumps off; cold outside temperatures provided ample cooling without the chiller having to be run, substantially lowering power bills. When the outside temperature topped 40°F, however, the cooling tower no longer could handle the job alone, and the chiller had to be brought online. When the chiller was started, the cooling-tower water was routed through the condenser and the building water through the evaporator for the necessary 42°F chilled water to be provided.



Johnny gave the piping a quick onceover as the chiller sat idle. He traced the cooling-water piping from the tower, through the three-way valve, past the manual-shutoff gate valve, and to the chiller-condenser connection. The three-way-valve arrangement consisted of two butterfly valves linked together with a common actuator. The linkage closed the valve to the condenser as it opened the valve to the cooling tower.

“OK,” Johnny said. “Start it up.”

Hank punched a few buttons on the BAS operator workstation, and the two watched as the three-way valves changed positions to route cooling-tower water and building water through the chiller. Droplets of condensate on the uninsulated gate valve shook loose as the actuator turned the valve shafts. The chiller ran for a few moments, wheezed, and coasted to a stop.

“See?” Hank exclaimed. “And look at the fault message.” He pointed to the chiller control panel and a message reading “Surge—High Suction Superheat.”

“High-suction superheat? What’s that supposed to mean?” Hank asked. “There’s no load on the chiller yet. The return-water temperature is 46°F. How can there be high superheat? There’s probably no superheat at all. This controller has got to be bad.”

Just then, Sen. Heapeleach burst into the room.

“Hoovestahl, did you get that chiller running yet? If not, I’m going to sue that chiller company for all it’s worth and run you out of town on a rail!”

“Don’t worry, Senator,” Hank replied. “It’s just a bad controller. I’ll get another one flown out here ASAP.”

“Hold on just a minute, both of you,” Johnny interrupted. “You can fix this problem for a lot less time and money than a new controller. Your problem isn’t in that electronic brain; it’s in that butterfly valve.”

“What are you talking about?” Sen. Heapeleach angrily replied. “Obviously, there can’t be any superheat problem with no load on the chiller. The controller’s belly-up!”



“On the contrary, Senator,” Johnny said, “it’s the valve linkage that’s the problem. The tipoff is that condensation on the gate valve to the chiller condenser downstream of the automatic butterfly valve.

“The condensate on the body of the isolation valve means cooling-tower water is leaking past the butterfly valve and through the chiller condenser when the chiller is off,” Johnny continued. “Over a couple of weeks, that causes all the refrigerant to be drawn into the condenser because it’s the coldest place on the machine. When the compressor starts up, there is no liquid refrigerant in the evaporator to cool the suction line and the compressor impeller. So, the suction elbow heats up, and the sensor trips the superheat safety.

“All you have to do, Hank,” Johnny added, “is close that manual isolation valve for a few hours, stop the flow of cold water through the condenser, and let the refrigerant redistribute itself between the evaporator and the condenser. Then, open the manual valve, and start up the chiller normally. As soon as condenser-water flow is proved, it’ll start up and run like a dream. You can adjust the linkage any time.”

“I have to hand it to you, Johnny; you are one smart cookie,” Sen. Heapeleach replied. “Come on over to Jorgensen’s for a cold one on me. And bring your dog, too!”

“Don’t mind if I do, Senator,” Johnny said, “but Gas Train better stay in the car. The last time we went there, he got into the lutefisk and couldn’t come into the house for two weeks!”

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# FREEZE-PROTECTION FREEZE-OUT

At Rosebud County Vocational Technical School, the freeze-protection thermostat on a new rooftop air-handling unit is tripping continually. To Facility Manager Jonas “Wooly” Wolcott’s surprise, Johnny Tundra believes the solution to the rooftop problem lies in the boiler room.

JANUARY 2016

The drive to Rock Springs, Mont., was as peaceful as could be this cold January morning. The old two-lane road was in poor repair, but the snow and ice that filled the potholes made for a smoother-than-usual ride. Johnny Tundra was behind the wheel of the International Harvester Scout, his trusted basset hound, Gas Train, by his side, asleep as usual. A bump in the road raised the hound to semi-consciousness and caused a general relocation of his capacious jowls.



“No need to get excited,” Johnny said reassuringly.

The pair’s destination was Rosebud County Vocational Technical School, a sprawling campus of a dozen or so buildings totaling a little over 80,000 square feet. The eastern Montana prairie was dry as a bone and clear most of the time, with temperatures dropping rapidly at night, sometimes by more than 30 degrees. The traveler always wanted to be prepared.

The school was planning an addition to its 1940s-era library and classroom (LC) building. A 1988 remodel of the building saw the conversion of the steam heating system to hot water using five modular gas-fired fin-tube boilers staged for efficiency. The original steam radiators now were filled with hot water and worked in conjunction with a new rooftop air-handling unit that provided ventilation air.

Johnny was on his way to the school to discuss the planned addition with the facility manager, his old pal Jonas Wolcott—better known as “Wooly” for his national-forest-sized beard—and get an edge over the competition for the design contract. Johnny took the Rock Springs exit, passed the Home Run Bar and Grill, and slid the trusty Scout into the shop parking lot. He and Gas Train dismounted and went inside.



“Anybody home?” Johnny called out upon entering the cramped shop area, piled to the ceiling with racks and shelves of boxes and equipment.

“Back here,” Wooly replied from the building-automation-system operator workstation at the rear of the plant. “That rooftop unit on the LC tripped out again last night, and the building was cold as a refrigerator this morning. The perimeter fan coils keep things from freezing, but that doesn’t help the staff when they show up in the morning. They’re cold—and mad as wet cats.”

Wooly explained the building automation system shut down the rooftop



unit during unoccupied hours to save energy. At night, the clear winter skies and low temperatures would cool the rooftop unit to the point its freeze-protection thermostat would trip. Until it was manually reset, the freeze stat would prevent the rooftop unit from starting. Wooly would start up the unit when he arrived at 7 a.m., but that was not early enough to warm spaces before the staff and students arrived.

“Why don’t you replace the freeze stat with an automatic-reset unit?” Johnny asked.

“Can’t take a chance on the coil freezing,” Wooly replied. “The coil is protected by a local circulation pump on a secondary branch circuit, but that only provides marginal protection. If the AHU fan were to start in sub-zero temperatures, it would freeze the coil before the freeze stat could react. Better to have someone at the unit to make sure it starts with the control valve wide open and the boilers firing.”

“Moving the freeze stat further down the ductwork inside the building would reduce the nuisance trips,” Johnny offered.

“Can’t do that either,” Wooly said. “See, there’s no glycol antifreeze protection in the coil. When they converted the building to the hot-water system, they were afraid to put glycol in the old pipes. You know piping filled with glycol is more likely to leak than piping with pure water and makes a bigger mess if it leaks in walls and ceilings. So, they used a straight water system and double protection for the AHU coil: the freeze stat and the coil circulation pump.”

“Yep, makes sense to me,” Johnny said. “But I have an idea. The solution to your rooftop problem may be in your boiler room. Let’s go take a look at those modular boilers.”

“OK with me,” Wooly said, “but I don’t see what the boilers have to do with the AHU tripping problem. ... By the way, Gas Train better stay here. We have



enough IAQ problems on this campus already!”

The basement boiler room was clean as a whistle. The five modular boilers were laid out in a row with new supply and return mains overhead. Each boiler was connected to the mains with its own circulation pump, with a solid-state controller staging the boiler according to a preset program. The new boiler header piping was connected to the original iron piping where it disappeared into the wall chase. New supply and return lines from the mains served the new rooftop unit.

“Wooly, my boy, your troubles are over,” Johnny said after scanning the boilers and piping. “You have everything you need here; you just need to use it

a little differently. Rearrange this piping so that, instead of having all the boilers on a single header, you have two or three boilers serving the rooftop unit and the rest serving the old perimeter radiators. That way, you can add glycol to the rooftop AHU system while running straight water in the old perimeter piping.

“Once you have glycol in that rooftop unit, you can replace that existing freeze stat with a self-resetting model and move it downstream, farther into the building,” Johnny continued. “With the coil protected with anti-freeze, you only have to protect the building itself from being exposed to frigid air in the event of a boiler or control-valve malfunction. That should eliminate the nuisance trips and get that unit started on time for early morning warm-ups.

“Hire an engineer to model the building and calculate how many boilers are needed to serve the perimeter system and how many should serve the AHU,” Johnny concluded. “Also, don’t forget the AHU heating coil and boilers will be de-rated a little by the addition of the glycol to the pure water. Still, the switch should be do-able.”

Wooly thought for a minute.

“Sounds like a great idea, Johnny,” Wooly said. “We could add that bit of work to the expansion project with no problem. Thanks for the tip. And I won’t forget where I heard it during the selection interviews, either. Now, let’s get back to the shop and let Gasser out before the smoke alarms trip!”

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# FOUNDERING FURNACES

Amid sub-zero temperatures and 80-mph winds, two of four furnaces serving the State Lands headquarters continually are tripping off. Could the problem be ice crystals in the fuel line? The facilities manager, Pete "Plug" Lipcheau, has cleaned the fuel filters and blown out the fuel lines to no avail. Plug is about to come uncorked when he asks his pal Johnny Tundra to take a look.

MARCH 2016

This particular Montana day was cold, even by late-January standards. Johnny Tundra was behind the wheel of his 1972 International Harvester Scout, cruising west on Highway 2, just south of the Canadian border, along Jim Hill's Great Northern Hi-Line.

The wind out of the west felt strong enough to slow a locomotive. Westerlies carry moist Pacific air first over the Cascades and then the Rockies, the air losing much of its moisture along the way. Flowing down the eastern slopes, the air accelerates to make up for its reduced mass. The science behind the 100-mph wind, however, never is as impressive as seeing a car door blown off its hinges or a garage picked up and dropped some distance away as kindling.



The wind always accompanies a weather change, and the weather had turned cold, with nighttime lows well below zero. The old Scout bucked and heaved under the gusts, but there was little on the prairie to indicate it was windy outside—just an occasional tumbleweed bouncing out of the west at the speed of a small plane.

Johnny's thoughts ran to the State Lands headquarters in Cut Bank. A single-story brick structure with a steel roof and plenty of insulation, the building was as tight as any. But they all leak. Amid sub-zero temperatures and 80-mph winds, it needed every one of its four oil-fired furnaces to stay warm.

Hence, the panicked call from Johnny's pal Pete "Plug" Lipcheau earlier.

"I just can't get these two furnaces to stay lit!" Plug exclaimed. "One and Two are fine, but Three and Four will run for a couple of minutes and then stop dead. I've cleaned the fuel filters about 10 times, and it doesn't do any good.



I've blown out all the fuel lines, too, and the same thing happens. Half the time, I put everything back together, and the furnaces run fine. Then, I come back in the morning and find they tripped off during the night, and the place is freezing cold. I'm going nuts!"

The first thing that came to Johnny's mind was ice crystals in the fuel line. He knew day and night temperatures varied considerably on the Hi-Line. The most rapid temperature rise ever recorded in the lower 48 states happened 110 miles away in Great Falls, when the temperature rose from  $-32^{\circ}\text{F}$  to  $15^{\circ}\text{F}$  in seven minutes. The Hi-Line also held the national record for greatest difference between all-time low and all-time high temperatures:  $187^{\circ}\text{F}$ !

Such dramatic temperature swings cause condensation in fuel tanks, especially when the tanks are above ground, the way the EPA likes them. Over the year, the oil tank probably accumulated a lot of water that froze into ice crystals and plugged the furnace filters. Then, the furnaces shut down on thermal flame protection and stayed down until manually reset.

"Plug, did you put that fuel dryer in your fuel tank?" Johnny asked. The fuel dryer was isopropyl alcohol that dispersed water so it did not freeze into crystals large enough to clog filters.

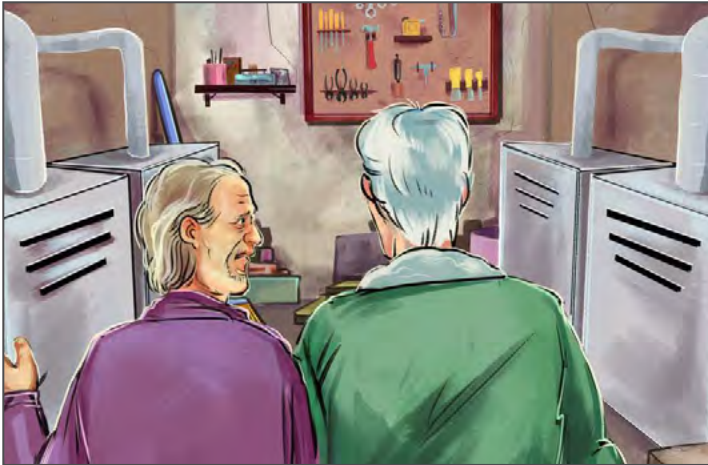
"You bet I did—and triple the recommended dose, too," Plug replied.

"Is the day tank level normal?" was Johnny's next question.

"Right where it's always been," Plug said, "but those furnaces are shutting off just the same."

“Sounds mighty confusing to me,” Johnny said. “I better come up and take a peek.”

Johnny slid the Scout into the State Lands headquarters parking lot, his trusted basset hound, Gas Train, by his side. Plug came out to greet them. As Plug opened the passenger door to let out Gas Train, a gust of wind nearly carried him—and the door—away. Gas Train barked blindly at the commotion, sliding off the seat and onto Plug’s feet. Plug fell to the ground as Johnny exited the vehicle.



“No time to waste playing with the dog, Plug,” Johnny joked. “Let’s go round up those furnaces of yours.”

As he entered the mechanical room, Johnny saw the furnaces—two against the wall to his left and two against the wall to his right. All four concentric combustion air/flue pipes went straight up through the roof. Building ventilation air for each pair was piped through the wall and directly to a fan intake plenum.

“It’s those two that are causing all the trouble,” Plug said, pointing to the two units on the left. “There’s the day tank, and there’s the oil line from the storage tank.”

The line from the outdoor storage tank was encased in ice, but everything seemed to be working normally. As Johnny looked at the outside-air dampers, the two furnaces suddenly clicked and went silent.

“And I just reset those!” Plug exclaimed. “What’s going on? Come on; let’s go see what’s wrong with that fuel tank.”

“Whoa, partner,” Johnny said. “I have a feeling your problem’s not at the fuel tank; it’s right outside this wall. These furnaces are short of something, but it’s not fuel. Let’s take a look.”

As they came around the southwest corner of the building, a biting gust of arctic air knocked them back. Johnny recovered his balance and motioned at a lump of sheet metal on the ground.

“Looks like that intake-air hood has seen better days!” Johnny yelled over the suddenly howling wind.

“Yeah, it was torn off by the wind a couple of weeks ago, and I’ve been too busy working on these furnaces to put it back!” Plug replied.

“If you’d have put it back, those furnaces would be working!” Johnny yelled in Plug’s ear. “That missing hood is your whole problem! The hood deflects the wind and moderates the pressure on the ventilation air intakes! With the hood off, those air intakes take in so much air that it chills the combustion



chambers, and they can’t make temperature when the furnace fires! So, the furnace fires for a couple of minutes and then shuts down on low temperature! The safety circuits think the furnace hasn’t ignited because the combustion chamber is too cool!

“For a quick fix, cut down the outside air, and that should get these balky burners back on line!” Johnny continued. “You notice the two faulty furnaces have their dampers half open, while the working units have their dampers nearly closed? The problem units are probably taking in more ventilation air than is required for the few people in the building!

“In the summer, you’ll want to adjust the ventilation dampers wide open to cool the building in the early morning, but in the winter, you should take in the least outside air the code requires!” Johnny concluded.

“Johnny, you may just have something there,” Plug yelled, ducking a low-flying tumbleweed, “but if we don’t get out of this wind soon, I’m going to be freeze-dried! Let’s go!”

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# NO DELAY

Early one January morning in northeast Montana, where even moderate winter conditions result in wind chills of 50 below, Twitch Griswold, facilities manager for the U.S. Customs and Border Protection station in Big Beaver, calls his old friend Johnny Tundra in a panic—the building’s four boilers are tripping out on high temperature every time Twitch turns around. Luckily for him, Johnny has his back.

MAY 10, 2016

It was a chilly January morning in northeast Montana. The plains were covered in snow swept into dunes by the relentless wind. The drifts formed ragged edges running along the highway, punctuated by sagebrush and sawtooth grass keeping a ragged parallel with the barbed-wire fences.



With the temperature hovering just above zero, it was little wonder Twitch Griswold, facilities manager for the U.S. Customs and Border Protection station in Big Beaver, had called his old friend Johnny Tundra in a panic—a boiler stopping in the middle of the night in these conditions was no laughing matter. Even moderate winter conditions in these parts resulted in wind chills of 50 below. That could cool down the 20,000-sq-ft, single-story building mighty quick. Johnny took another sip from his stained plastic convenience-store coffee mug and considered the problem at hand.

The facility had a simple heating system consisting of three air-handling units, perimeter fin-tube radiation, and a handful of unit heaters. The hydronic loop was heated with four gas-fired modular cast-iron boilers rated at 145,000 Btuh each. The boilers were ganged together into the heating water main and sequenced by an application-specific controller. Each boiler had come from the factory with its own burner controls; in the field, a small circulating pump was plumbed and wired for each boiler.

“I told them they were making a mistake taking out that old Iron Fireman,” Twitch growled over the phone in the early morning darkness. “That old boiler was barely 70 years old and in the prime of its life—like that dog of yours. Ha, ha!”

As Twitch chortled, Johnny reached for an extension cord and connected his bedroom light. “Got to get that light wired this weekend, for sure,” he thought in reference to the perpetual remodel of his Big Timber bungalow. “These extension cords will be the end of me yet.”

“You told me they ran fine this summer, Twitch,” Johnny said. “In fact, they ran fine last month. What happened?”

“I don’t know what happened,” Twitch replied. “All I know is that they are tripping out on high temperature every time I turn my back, and when that happens, I have to make a special trip up here and reset the burners before this place freezes solid. I’m losing my beauty sleep!”

“And you need that,” Johnny deadpanned. “Have you checked the temperatures in the boiler outlet pipes when they trip? Are they high?”

“The contractor didn’t install thermometers in each boiler’s piping, only on the main supply and return,” Twitch said. “But I’ve wrapped a couple of thermometers onto the piping with bailing wire, and the temperatures don’t show being too high. Because of the outside-air reset, the boiler aquastat set-points are up at about 180°F, and that’s about what the thermometers show. But I figure they must be reading low because the boiler high-limit safeties are set at 220°F. But ever since the weather turned cold last week, they’ve been tripping non-stop!”

“OK,” Johnny yawned. “Let me go fire up the Scout, and I’ll see you in a



couple of hours. In the meantime, keep checking those temperatures.”

As Johnny pulled up to the door of the U.S. customs station machine room in his trusty International Harvester Scout, a staffer from the Canada customs station on the other side of the border waved. A voice came out of a fur-lined hood as big as a beer keg: “Warm enough for you, eh?”

Johnny responded with a wave. “Just right!” he yelled as he grimaced into the north wind and knocked briskly on the machine-room door.

Twitch was at the door in a heartbeat. “‘Bout time you got here,” he said in faux anger. “What’d you do, ride that hound of yours?”

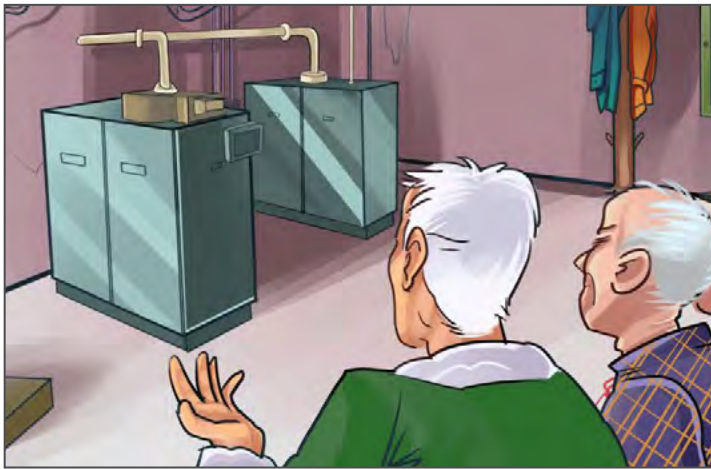
“Settle down, Twitch, and let’s get to the bottom of this boiler boondoggle,” Johnny replied. “Which one is the problem?”

“All of ‘em,” Twitch said. “Every single one.”

“And they all were working fine a couple of weeks ago?” Johnny asked.

“Like clocks,” Twitch answered.

“And you’ve checked all the outlet temperatures when the boilers trip?”



Johnny inquired.

“I’ve been standing here watching ‘em cycle on and off for three days now,” Twitch responded. “I’ve checked the temperatures when they start, when they’re runnin’, and when they stop. No matter when I check ‘em, the temperature reads what it’s supposed to, about 180°F. Then, the next time the boiler tries to start, its high-limit is tripped. The only thing I can figure out is that these safety controls all went bad. Must have been a bad batch or something. But they sure didn’t last long. They just don’t make ‘em like they used to. I never should’ve let ‘em take the Iron Fireman, energy conservation or no.”

Johnny observed that three of the four boilers were firing. As Twitch finished his diatribe, No. 3 shut off. Johnny went up to the unit and felt the inlet piping.

“You got one of those makeshift thermometers of yours handy?” Johnny asked.

Twitch handed a thermometer to Johnny, who placed it against the bare copper pipe and wrapped it with bailing wire. In short order, the indication rose to the 180°F setpoint.

“Twitch, put your hand on that secondary circ pump,” Johnny requested. “Gentle now; it’s a little hot. What do you feel?”

“Nothing,” Twitch said.

“Right,” Johnny replied. “That’s because the pump is off. It went off when the boiler went off. I’ll bet you bear mittens to buffalo muffins that if you read the engineer’s sequence of operation it says that the secondary circulation



pumps are supposed to run five or 10 minutes after the boiler shuts off. That extra run time allows the secondary loop to dissipate the heat that’s built up in the boilers’ cast-iron internals. Those high-limit safeties are smart enough. It’s these pumps that need a brain adjustment.

“When the pumps were wired, they were supposed to be wired with a delay relay,” Johnny continued. “That relay had to be supplied by the controls contractor. Oftentimes, the contractor is in a hurry and doesn’t read the sequence of operation. As a result, the electrician just wires the pump to the auxiliary contact for the burner. When the burner is off, the pump is off. No delay.

“At cooler boiler settings, the residual heat of the boiler internals may not be sufficient to drive the boiler water temperature over the safe limit,” Johnny concluded, “but as the boiler setpoint increases, there comes a point where the residual heat trips the safety five or 10 minutes after the boiler shuts down. Look at that thermometer now. The water temperature has risen to 210°F. Now check the safety. You see, it’s tripped.”

“I guess I never thought to check the water temperature five or 10 minutes after the boiler had shut off,” Twitch said. “I figured it had to be a lower temperature than when the boiler was running.”

“My advice,” Johnny said, “is to get some adjustable delay relays installed for those pumps. Then, get some thermometers installed at every individual boiler inlet and outlet so you’ll always know how these puppies are running. And next time, maybe you’ll listen to me and have these boiler retrofits commissioned. A commissioning authority likely would have caught this.”

“Sure thing, Johnny,” Twitch said, “and don’t delay your next visit to Big Beaver!”

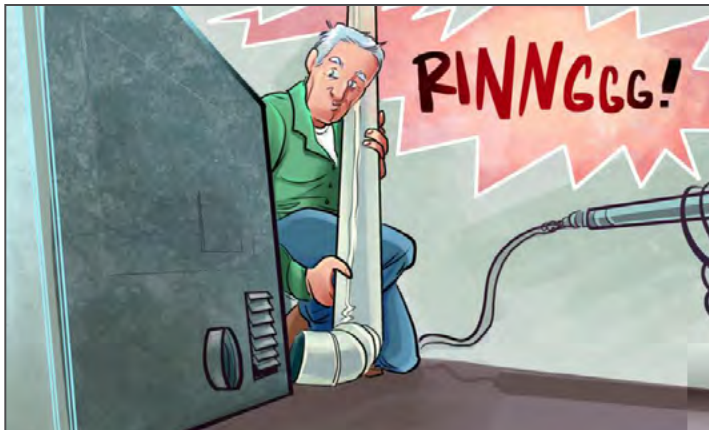
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# HIGH-HEAD CHILLER TRIP

It is back to school for Johnny Tundra, who returns to Rosebud County Vo-Tech. A chiller keeps tripping offline on high head pressure. How can the chiller have any load on it when the temperature outside is 15°F? Lead designer Jerry Seltzer is ready to replace the chiller, fire the mechanical contractor, and sue the controller provider. Fortunately for everyone involved, Johnny has an advanced degree in troubleshooting.

JUNE 2016



As part of the perpetual remodel of his Big Timber bungalow, Johnny Tundra was kneeling behind his clothes dryer, about to connect the vent, when his phone rang. On the other end was Jerry Seltzer, owner of Seltzer Architects, the lead design firm for the expansion of the library and classroom building at Rosebud County Vocational Technical School. Jerry had chosen Johnny as the HVAC consulting engineer for the job. He and Johnny had known each other since college and had a long-standing practice of cooperation through constructive disagreement. Jerry was frothing at the mouth.

“The mechanical system supposedly is finished, but the contractor says he can’t get the chiller to run, no matter how hard he tries,” Jerry exclaimed. “The thing keeps tripping offline with some readout like ‘high head’ something or other, but there’s no way the chiller can have any load on it when the temperature outside is 15 degrees. We have to run all the boilers just to heat the building to 60 degrees to dry out the Sheetrock. I’m about ready to disconnect this piece-of-junk chiller and get one in here that works!”

Johnny told Jerry to settle down before he ruptured his relief. He said he would be right over to eyeball the situation.

An hour later, Johnny, his trusted basset hound, Gas Train, by his side, was sliding his International Harvester Scout into the facilities-services parking lot behind the school’s maintenance shop. His old pal Jonas Wolcott—better known as “Wooly” for his national-forest-sized beard—was waiting for them at the door.

“Are you ever a sight for sore eyes,” Wooly said. “That chiller tripped again just a few minutes ago. I checked out the diagnostics on the workstation. The readout said ‘high head pressure,’ but that’s an error. There’s no thermal load on the chiller, and without a load, there can’t be high head pressure.”

“I locked all the AHU cooling-coil valves closed through a global command at the BAS,” Wooly continued. “Even if they were open, there’s no load in the building at this temperature.”



“Your pal Seltzer is about ready to fire the mechanical contractor because he can’t get the chiller going, and we need it to cool those computer rooms,” Wooly concluded. “No chiller, no computer rooms, and no summer session equals a giant lawsuit.”

“Well, I reckon that’s why we have engineers on these projects,” Johnny said. “Let’s go take a look at that reefer of yours firsthand, and maybe we can figure something out.”

The pair, with Gas Train in tow, headed to the mechanical room. The space had been expanded to accommodate an additional boiler and equipment. The boilers were running full out to heat the semicompleted library-and-classroom-building addition, with the uninsulated piping and equipment making the mechanical room too hot for comfort. The wall thermometer was maxed out at 100°F.

Johnny noted the big unit heater, wires dangling down.

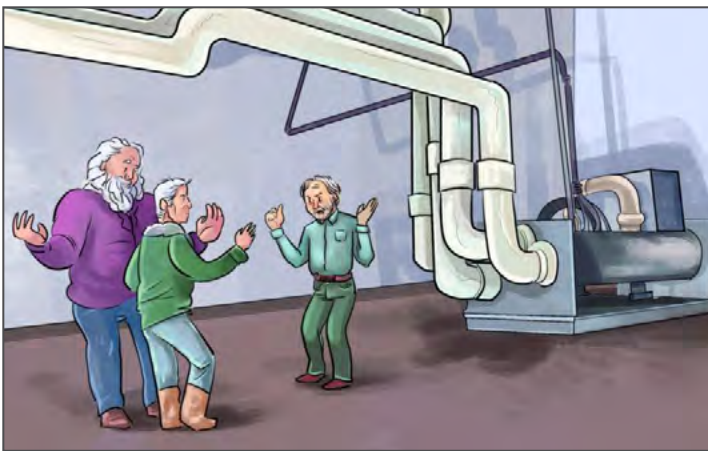
“Don’t want to forget to hook that up,” he thought.

The chiller vault was cool and comfortable. The mechanical contractor was hunched over the chiller control panel and talking with Jerry, mostly in words not in Webster's.

"Hi, Jerry. How's it going?" Johnny asked.

"Terrible!" Jerry shot back. "This controller is busted. The chiller is locked out every time we try to start it. It says 'high head pressure,' but there's no load. They sent us a defective controller, and I am going to sue the pants off 'em for it."

Johnny gave the chiller a quick once-over. The unit was piped and wired, and the installation was complete right down to the insulation. He saw the chilled-water supply and return lines disappear into the pipe chase and two branch pipes take off into the machine room.



"This installation looks fine to me," Johnny said to the foreman, "except for the thermometers on the chilled-water lines. Where are they?"

"They were value-engineered out of the project, and the test fittings haven't been installed yet," Jerry said. "No big deal; we can't do final balancing until we get this chiller started anyway. And it looks like that isn't going to happen for a while."

"Get started unhooking this controller, and get a replacement on the way as soon as possible," Jerry told the chagrined contractor.

Johnny bent down and put his hand on the casings of the chilled-water circulation pumps. Then, he glanced again at the chilled-water branch piping to the machine room. A smile formed in the creases of his weathered mug.

"Hold on, Jerry," he said. "Your problem's not in the controller; it's in the machine room."

"Johnny, you have really lost it this time," Wooly said. "What in the world are you talking about?"

"Just take a minute and put one of those test ports on the chilled-water return line," Johnny said. "We should have had thermometers all the time, but those test ports will work to demonstrate why the chiller won't start."

Ten minutes later, a test port was in the chilled-water return line, a bimetal test thermometer was in place, and the three watched as the indicator climbed from 60°F to 70°F to finally over 90°F.

"There's no way that thermometer can be right," Jerry exclaimed. "There isn't a cooling load in this building that's 90°F."

"Just the opposite," Johnny said. "The only load in this building is quite a bit warmer than that: the machine room!"



"You were right, Jerry, when you said there was no load in the AHUs because it was too cold and the valves were all locked closed," Johnny continued. "But you forgot the one load in the building that wasn't an AHU. As you may recall, we were concerned about overheating the machine room because the heat could damage the air-cooled compressor. So we put in a unit heater and piped it into the chilled-water circuit to cool the room, if need be."

Johnny went on: "That unit heater was shipped complete with its own solenoid valve to control water flow. Because the unit was intended for heating, the valve on the unit fails open on a loss of power. The heater isn't wired yet, but it's piped, so the coil has full flow in that hot machine room. It made no difference that you locked out the cooling because that unit isn't connected to the BAS."

"So, with the circ pumps on and all the AHU valves closed, the maximum possible flow was being run through the unit heater in the hot machine room," Johnny added. "That made the return chilled water too hot for the chiller to handle, and it tripped out on high head pressure before it could cool the loop."

"If you close the isolation valves to the unit heater and stop that branch's flow, your chilled-water temperature will cool down to the point where you can start the chiller," Johnny concluded. "Once the loop is cool and the chiller is running, you can connect whatever loads you want."

"Johnny, I hate to say it," Jerry said, "but it looks like another round for the engineers on this chiller mystery. And value engineering or no, I am going to get a change order in right away to put those permanent instruments back into the chilled-water lines!"

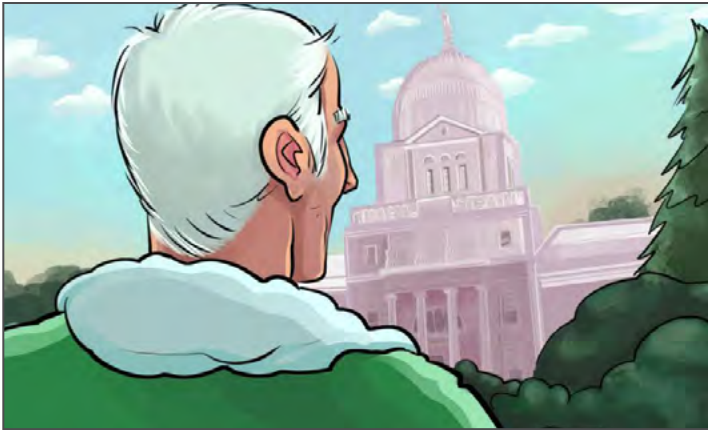
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# PLUGGING A GOVERNMENT LEAK

*There is a leak at the highest reaches of the Montana state government—the kind not associated with a loose-lipped staffer, but, rather, a safety relief valve on a 40-year-old boiler. The supervisor of facilities maintenance and operations, Hank Hoovestahl, wishes the environmental guys who decided to connect the steam boiler to a newer hydronic boiler would have talked to the O&M staff first. Luckily for Hank, he does not have to ask his pal Johnny Tundra twice for help.*

JULY 2016



**D**riving west through Harlowton on the slopes of the Crazy Mountains, Johnny Tundra recalled swearing that, after his last job at the state capitol in Helena, he was through with politics. His old pal Hank Hoovestahl, however, needed help.

Hank, the supervisor of facilities maintenance and operations, had a boiler safety relief valve that would not shut off. Hank had just started operating and maintaining the capitol-complex buildings, many of which recently had seen energy retrofits. Hank told Johnny the building in question, the Knippel building, had undergone several improvements aimed at reducing its high natural-gas consumption. The retrofit lowered the energy bills all right, but now the system was losing water daily through the chattering relief valve.

Built in 1957, the three-story structure received a major addition in 1974. The original 15-psig steam boiler was left to serve the original building, while the addition was fitted with a new hydronic boiler. Both systems worked fine, but used excessive amounts of energy. The original boiler was so oversized it could serve both the old and new portions of the building by itself. Operating both boilers at part load over the course of a winter resulted in short-cycling and low efficiency. To correct this problem, the boilers were connected. This allowed the steam boiler to be used to heat both the original building and the addition on cold winter days and the smaller hydronic boiler to be used during the warmer spring and fall seasons. This added reliability, as the second boiler always was available if the first had to be shut down. As part of the energy

facelift, the original steam boiler was converted to water service, giving the building a single hydronic loop.

There was only one problem with lashing the two boilers: The safety relief valve on the old boiler leaked. The pressure of the three-story water column apparently was too much for the 15-lb relief valve. It did not leak all of the time, but it leaked enough to waste costly antifreeze and erode the valve seat. Even worse, the marginal system pressure allowed air to collect in the third-floor air-handling unit's (AHU's) heating coil, reducing the AHU's capacity to the point it no longer could heat its area.

"Saving energy is all well and good," Hank grouched as he led Johnny to the Knippel machine room, "but not if we dump a couple hundred gallons of glycol down the drain every winter and can't heat the third floor. I can use the new smaller boiler to heat the building for about eight months of the year, but it's not big enough to handle the load in the winter. I wish those environmental guys would talk to the O&M staff before they get these great ideas instead of after!"



"Maybe it's time to replace that old kettle with a new unit," Johnny offered. "If you bought a new boiler rated at 30 lb, its 30-psig relief valve would never leak."

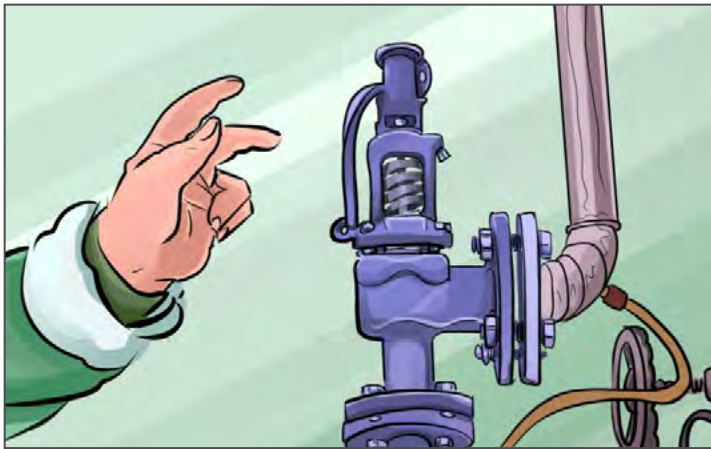
"Try telling that to the legislature," Hank retorted. "That 40-year-old boiler is in the prime of its life, according to those guys. Plus, it's in a basement mechanical room with no access. Any boiler change-out would be expensive and disruptive to the building occupants. My boss said, 'No replacement—make it work!'"

The pair went down a steep flight of stairs to the basement. The boiler room was a dungeon-like pit in the bowels of the foundation.

“You’re right: no access to this place,” Johnny said. “By the way, where are the main circulating pumps?”

“Over in the new boiler room,” Hank replied. “When we piped the boilers together, we upsized the hydronic heating pumps serving the new addition and now use them to pump through both boilers. That old steam riser over there is now the heating-water riser for the old portion of the building. We circulate the water from the new machine room, through the old boiler, up and down the risers, and back to the new machine room. By the way, there’s the leaking relief valve.”

“Hmmm, it’s not leaking now,” Johnny observed.



“Yeah, but it will, believe me,” Hank replied. “It doesn’t leak all the time, but when it does, it pours. But what frosts my hackles is that we measured the water column on the boiler, and it’s less than 35 ft, which results in a pressure head less than the 15-lb-relief-valve rating. We’ve replaced the valve, and it doesn’t make any difference. Sometimes it leaks, and sometimes it doesn’t. I’m at the end of my rope!”

“Now, don’t get your nose in a tetch,” Johnny said. “Let’s take a stroll over to the new addition. Your valve may be leaking here at the old boiler, but I’ve got a feeling the problem is in that new machine room.”

Entering the new machine room, Johnny noted the two base-mounted heating pumps.

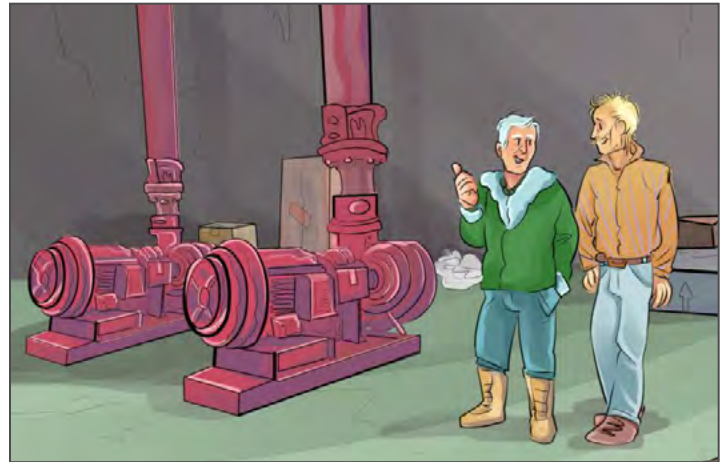
“Pretty husky fellers,” he mused. “Do these run all the time?”

“No, only on a call for heat from either the new or old section of the building,” Hank replied. “What are you getting at?”

“Well, here’s my take on the situation,” Johnny began. “Your old boiler’s fine with the static head from the building. That’s not what’s causing the relief valve to lift. It’s these pumps that are the problem. When they run, they pressurize the old boiler, and that’s what dumps the water. With the pumps off, there’s no over-pressure and no leakage. If you go over to the old boiler and I start these pumps manually here, I bet you’ll see that valve open the moment the pumps start.”

“Well, that’s great news, brother, but without the pumps, how do we heat the building?” Hank asked.

“You can still use the pumps,” Johnny explained, “but you have to arrange them differently. Move these pumps to the old machine room and pipe them so the old boiler is on the suction side and the heating riser on the pressure side.



That way, your top-floor AHU coils see the highest-possible discharge-pump pressure; and when the pumps run, the head on the boiler is reduced, not increased. That should keep the air out of your third-floor air-handling-unit coils and also stop the relief valve from leaking.

“Since the new boiler has the higher 30-psig pressure rating, it shouldn’t be any problem to pump from the old machine room, through the building, and back through the new boiler,” Johnny continued. “But doing it the other way was just too much for the 15-psig relief valve on the old boiler.”

“Sounds too easy,” Hank replied. “But I’ll consider it over a couple of cold ones at Big Dorothy’s. You coming?”

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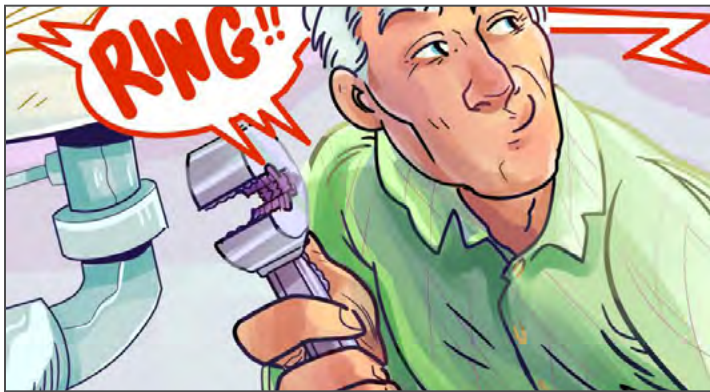
# COMPOUNDING THE PROBLEM

The steam sterilizer at Stony End Home for the Aged is water-logged. If it shuts down, clinic operations will come to a screeching halt, with the next-closest medical facility more than two hours away. Luckily for Facilities Manager Thatcher "Thatch" McGowan, his old pal Johnny Tundra is only a phone call away.

JANUARY 2017

It was a brisk January morning in south central Montana. The wind was kicking up, sweeping snow across the plains in streaks of frosty smoke. The sun was bright, and it was easy to forget the outside temperature of  $-10^{\circ}\text{F}$ .

Today was the day Johnny Tundra was determined to finish the plumbing for his bathroom remodel, part of the perpetual rehabilitation of his Big Timber bungalow. He typically was too busy helping others with their projects to ever have time to finish his own. Wrench in hand, he reached for a pipe under the sink when, not surprisingly, the phone rang.



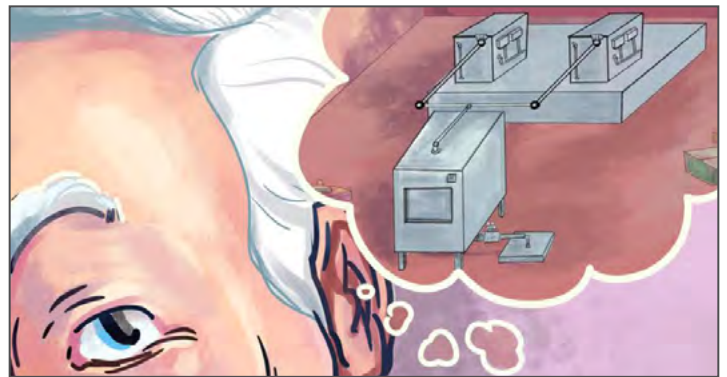
It was his old friend Thatcher "Thatch" McGowan, facilities manager at Stony End Home for the Aged in Angela, Mont. Thatch was in a panic: The facility's one and only steam sterilizer was water-logged; if it shut down, clinic operations would come to a screeching halt, with the next-closest medical facility more than two hours away in Wounded Bear, Wyo.

"Why me?" Thatch cried. "This sterilizer has always been bulletproof, and now it's flooded like a bathtub! And I know what did it: It was Boiler No. 2!"

"What do you mean, Boiler No. 2?" Johnny asked.

"Boiler No. 2 is the one that got re-tubed last fall," Thatch explained. "Those boiler makers crudded it up, and the sterilizer steam chest is plugged permanent. The chest is built into the cabinets. If we have to tear it down, it will be a week's work."

"Sounds like a puzzle," Johnny said. "If you want, I'll trot over and take a look. Nothing to do here but finish my house plumbing, and it's waited two years already. The roads are covered with ice, so it'll be an hour or so. Don't start tearing out the furnishings 'til I get there."



As he steered his 1972 International Harvester Scout into the parking lot of Stony End Home for the Aged, Johnny recalled the sterilizer system. It was pretty simple: two little steam generators hooked in parallel to the sterilizer. Steam condensed in the sterilizer, and the condensate drained through a strainer and steam trap to a receiver, where it was cooled and piped to a drain. It had worked fine for years, but now didn't work at all. Boiler No. 2 was rebuilt, but not flushed out. It figured—big-city guys always are in a hurry.

As Johnny approached the service entrance, he saw Thatch was waiting.

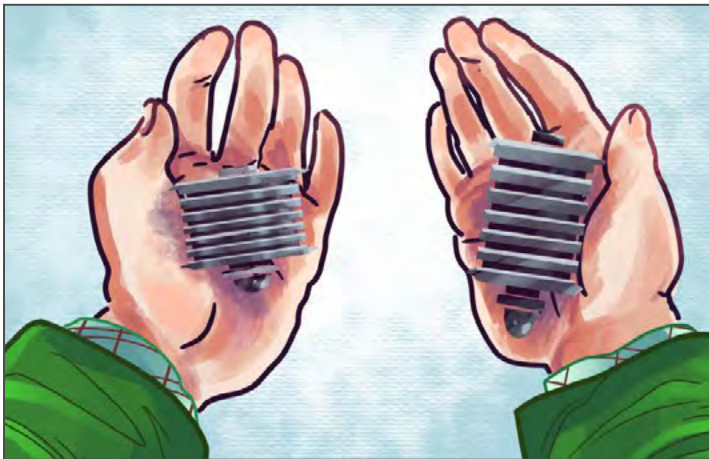
"What took you so long?" Thatch bellowed in mock anger. "You have to push that wreck from Big Timber?"

"Settle down, pardner, and let's take a look at that pressure cooker of yours," Johnny replied.

As Thatch led him to the sterilizer, Johnny remarked: "I see you've got the drain plumbing apart. Checking the trap and strainer?"

"Yep," Thatch responded. "When we couldn't make sterilizer temperature, we closed the valves on either side of the strainer and thermostatic trap and blew down the strainer. We knew the trap element was good because it was replaced when the boiler was re-tubed. We pulled it out and checked it for cracks and leaks anyway, and it was fine. Then, we put the expansion element back in the trap, closed the strainer, and opened the isolation valves, but condensate wouldn't pass down to the receiver. The dirt from the boiler rebuild clogged the coils, and we are in a heap of trouble."

"Don't get your nose in a tetch, because we're not going to let any water-logged steam chest rain on our parade," Johnny said. "Do you have another replacement element for your steam trap?"



Thatch produced a replacement element. They isolated the assembly, relieved the pressure, and removed the element in the trap. Johnny held the new element next to the one that had been removed.

“Do you see any difference?” Johnny asked.

The old element was about twice as long as the new one.

“The old element has been over-extended and is now permanently stretched,” Johnny said. “So, when you put it back in the trap, it closes the outlet valve and backs up condensate; and it won’t retract in the presence of the air and cool condensate, as it is supposed to.

“A thermostatic steam trap passes condensate when the element senses its lower temperature and contracts to open the trap outlet valve,” Johnny continued. “The element is a sealed bellows that is filled with material that expands to close the trap at higher steam temperatures. The damage occurred when you heated the trap with steam then isolated the trap and quickly opened the strainer blowdown valve. The trap element was hot, and the sudden loss of steam pressure allowed the bellows to over-extend and become permanently stretched. The clogged strainer was the original problem, but you created a new problem when you over-extended the thermostatic element by relieving the pressure before the element could cool.

“So, your system is clean now,” Johnny concluded. “Put the new element in the trap and gradually pressurize the system, and you’ll flow condensate as it contracts and opens the valve. But take your time when you check the strainer, so you don’t release the pressure before the trap element has a chance to cool. Remember, it was those city boys in a hurry that got you into this fix to begin with.”

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**D. Brian Baker**  
1959-2017

**Editor’s note:** This issue is dedicated to the memory of D. Brian Baker, who died Jan. 8, 2017, following a lengthy illness. Brian was president of Custom Vac Ltd., a Winnipeg, Manitoba, Canada-based provider of heating and air-conditioning services, and the instructor at Westech Energy Training Centre.

Brian’s stated goal was to do his part “to ensure that education and training remain the pillar of the success of the industry and our workforce.” Atop his list of interests was “teaching and mentoring young people.” From the publication of the first issue in May 2015, he was an ardent supporter of *Adventures of Johnny Tundra, Cold-Weather Engineer*, which he saw “as a way to help connect at a deeper level with” his HVACR and power-engineering students and “promote and excite the next generation of technicians.” Each time we published a new “graphic gallery,” he would contact me and request the story in PDF format for use in his classroom. In addition to exposing his students to *Johnny Tundra*, he did much to promote the series among his fellow HVACR educators.

Although I did not know Brian for very long or very well, he made quite an impression on me, as, has become evident to me since his passing, he did on many others. As his son, Donald E.A. Baker, who continues the family business alongside his mother and sister, wrote in tribute: Brian’s “passion was the HVACR industry. A guru. A mentor. A thought leader. A go-getter.

A genius. These are just some of the terms that I have heard applied when someone talks about my father. He was one of the few people I know that was always providing guidance for those around him while ensuring that we all held true to our responsibilities and obligations. He ‘held our feet to the fire,’ and it was a good thing...He was a family man, a businessman, a tradesman, a teacher, a volunteer, and so many more things to so many more people.”

Donald says his father “was all business right to the end.” Indeed, about a month before his passing, despite being confined to a bed, unable to teach, and facing a grim prognosis, he was thinking of his students, calling me to request a PDF of the latest issue of *Johnny Tundra* to share with them.

As Donald wrote: “The best way to remember Donald Brian Baker would be to never forget that we are all in this together. Everything he did in life revolved around that. He believed that every action taken and every word spoken has an effect. Whether it be the way we carry ourselves in day-to-day life or the way we approach our teaching methods or the way we look at codes and regulations, everything we do must be done with thought and care because the actions we take will ultimately affect everyone. In that, we are all responsible for one another.”

— Scott Arnold, Executive Editor  
February 2017

# SEWER PROBLEMS IN THE ATTIC

At Fish & Wildlife Region 9 headquarters, the toilets are backing up and Facility Manager Virgil “Eggshell” Coggeshell’s patience is circling the drain. Johnny floats the idea the source of the problem is in the attic. Will his theory hold water?

MAY 2017

Johnny Tundra was headed home following another big commissioning project in Miles City. The frozen tarmac disappeared over the horizon as the sun poked between the mountains and shed a frosty stream of light through the zero-degree February air. The drive to Big Timber was a long one, and Johnny and his travelling companion, his 15-year-old Basset Hound, Gas Train, needed a break, so the pair made a pit stop at Fish & Wildlife Region 9 headquarters in Fishtail, just off Beartooth Highway.

The headquarters consisted of a square, two-story office building with a large vehicle garage on one side and a smaller metal forensics building on the other. The facility was operated and maintained by Johnny’s old pal Virgil “Eggshell” Coggeshell.

“Hey, Egg, how’s it goin’?” Johnny yelled as he disembarked his 1972 International Harvester Scout. Gas Train echoed his owner’s greeting with an enthusiastic, if bewildered, bark.



“Ugh,” Egg, hauling a coil of sewer snake across the icy parking lot, groaned. “A bunch of toilets won’t drain, so I have to go swamp ‘em out again. Come on and give me a hand. But that hound of yours isn’t coming inside—it smells bad enough in there already. That’s another problem I got. Put Gasser in the carcass-storage building for a bit, and we’ll find him some scraps. It’ll probably be the best food he’s had in weeks!”

Inside the building, Egg threw open the door to a restroom and unceremoniously dumped the sewer snake on the floor. The janitor, who had just pumped out the remains of the last unsuccessful toilet flush, was standing by, glaring at Egg as if the whole thing was Egg’s fault. Two minutes later, Egg had expertly



shut off and disconnected the water, spun off the anchor nuts with his drill/driver, and lifted the water closet out of the way. He evidently had performed this procedure many times since the weather turned cold in late October.

“I can’t figure it out,” Egg said as he turned on the driver and spun the snake down into the sewer pipe. “I never had a problem with these drains for the 20 years I’ve been here, and now every john in the place is backing up. I’ve cleaned these drains all the way back to the septic tank, and nothing works. Not only that, but every floor drain in the place smells like rotten bear fat. They seem to be constantly losing their prime.”



“Frozen sewer lines?” Johnny asked. “It is chilly these days.”

“Ten below—you call that chilly?” Egg retorted. “It was 40 below every winter back in the old days, and these drains never fouled up like this. They’re buried 8 feet deep. Now these toilets back up every day.”

“So, what’s changed?” Johnny asked.

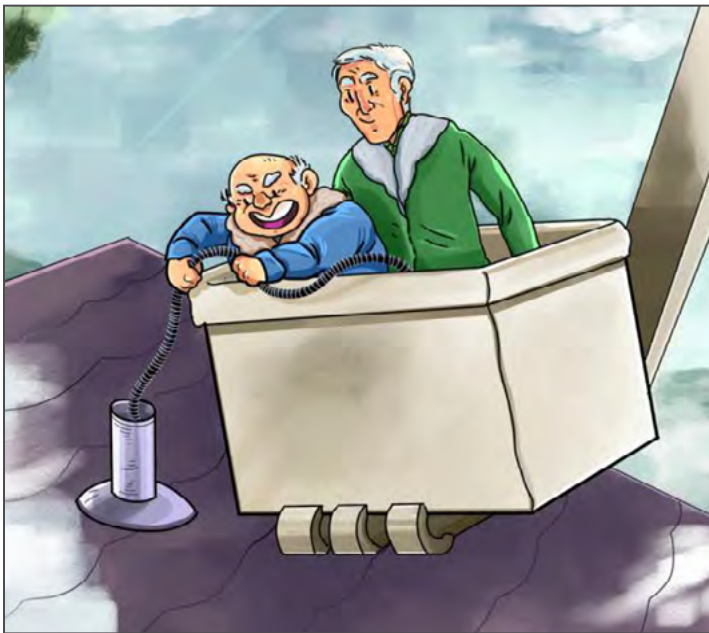
“Nothing to do with the sewer,” Egg said. “We had that energy retrofit, changed out some HVAC controls, put more insulation in the work sheds and office-building attic, and changed the fluorescent tubes—you know, the usual stuff.”

“No kidding—insulation in the attic, huh?” Johnny replied. “Did you add the insulation above the second-floor ceiling of this building and vent the attic space?”

“Naturally,” Egg answered. “You know I make them do it right.”

“You know,” Johnny said, “I’ve got a feeling your sewer problem isn’t in the ground; it’s in the attic. Let’s grab that cherry picker of yours and have a look-see.”

Twenty minutes later, Johnny, Egg, and the power snake were in the cherry picker hovering above the roof. The deep covering of snow testified the attic insulation was doing its job. On the way up, they checked the soffit vents and found them to be open. The attic was well-ventilated.



The wood-framed office building contained four restrooms, two on each floor, all sharing a common plumbing wall and vent.

“Now stick that snake down the vent and turn ‘er on,” Johnny instructed Egg.

As the snake started down the pipe, the two men were startled by what sounded like a cement mixer. The snake was chewing its way through something, something hard.

“Ice,” Johnny said. “You never had any problem with your sewer drains. The problem was the sewer vent. Before the new attic insulation, the vent was always warm and dry. But with the insulation over the ceiling, the attic dropped to the outside-air temperature. Moisture from the sewer lines condensed and froze in the vent and eventually clogged it with ice. At that point, your toilet flushing was hampered by the partial vacuum created upstream in the sewer line.

“Not only that, but when the toilets did flush, the slug of water moving down the pipe sucked your drain traps dry,” Johnny continued. “No matter how many times you refilled them with water, they were dry in a day or two from the suction caused by the plugged vent. That left a free path for the odors to travel from the septic system into the building. Get some heat tape on that vent pipe up in the attic, and your troubles should go away.”

“You know, Johnny, every time I see you, I think livin’ in that half-finished shack of yours in Big Timber has finally pushed you off the deep end,” Egg sighed, “but you’ve hit the bullseye again. Now, where did I put that heat tape?”

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# THE JACKHAMMERS ARE COMING!

At Stony End Home for the Aged, a new air-handling unit won't heat. All Facilities Manager Thatcher "Thatch" McGowan can figure is there is a leak in the cast-in-concrete ductwork. Jackhammers are on the way. Can Johnny keep them at bay?

JULY 2017



It was a brisk February morning, and Johnny Tundra was on the road to Angela, Mont. The wind was kicking up across the prairie, sweeping snow across the highway in blankets of undulating white. The sun was bright enough to blind. Inside the International Harvester Scout station wagon, it was easy to forget the subzero temperature outside.

Johnny was on his way to see his friend Thatcher "Thatch" McGowan, the facilities manager at Stony End Home for the Aged. Thatch was not a happy camper.

"Johnny, do you remember when you were here last month and fixed that balky steam trap, the one with the over-extended bellows that wouldn't drain?" Thatch asked during a panicked phone call two hours earlier. "Well, that same wing had a new AHU (air-handling unit) installed last summer, and it just won't heat! Everything was OK at first, but as the temperature has gotten colder, it's been harder and harder to get heating out of the AHU!"

"I've checked everything—the heating-water line, the strainer, the control valve, the coil, even the ductwork—and everything seems to be working fine," Thatch continued. "But the air coming out of the registers in the rooms is not warm enough to make the grade. We've had to move the residents out until the problem is fixed, and the superintendent is hoppin' mad. All I can figure is that there's a leak in the ductwork."

"And since the duct is cast into the concrete foundation, it's gonna be a disruptive job to dig it up, find the break, and fix it," Thatch concluded. "But I don't think there's any other solution."

"Digging up that ductwork is going to cost you a fortune in downtime and labor," Johnny said. "Give me a few minutes to put on my Carharts and warm up the Scout, and I will be over and sniff around a bit. We'll figure out how to get some heat into those rooms."

A little over two hours later, Johnny cruised into the back lot of Stony End Home for the Aged. Thatch was waiting.

"This is bad, Johnny," Thatch said. "The superintendent called up his contractor pal in Wounded Bear, and he's on his way with jackhammers. If I don't figure out something, they're gonna rip up the floor and pay for it with my maintenance budget. If that happens, I'm sunk."



"OK, then, we'd better beat feet to those ice boxes of yours right away," Johnny said.

Thatch led Johnny down the main hall of the new wing and into the first of the four problem rooms. The wall thermostat read 65°F, about 10°F below the normal temperature. Johnny's thermometer showed the supply-air temperature to be about 60°F—much too cool to heat the space to anywhere near the required 75°F, even with the fin-tube perimeter convectors heating at their full capacity. The conditions in the other three rooms in the group were similar.

"The crazy thing is, these are only four of the eight rooms on the same AHU," Thatch said. "The supply duct comes out of the AHU and splits into two branches. One branch heats these four rooms to the north; the other branch heats the four to the south. The four to the south are heating fine. In fact, their perimeter heat isn't on at all. These four to the north are freezing."



“Maybe we better go take a look at those warm rooms before we eyeball that AHU,” Johnny replied. “Lead the way.”

The two walked down the corridor and into the first of the four south rooms. The room was as cozy as could be. Johnny reached down and felt the fin-tube convector and then the air coming out of the supply register. The supply air was hot and the fin tube was off.

“Now, let’s go take a look at that AHU,” Johnny said.

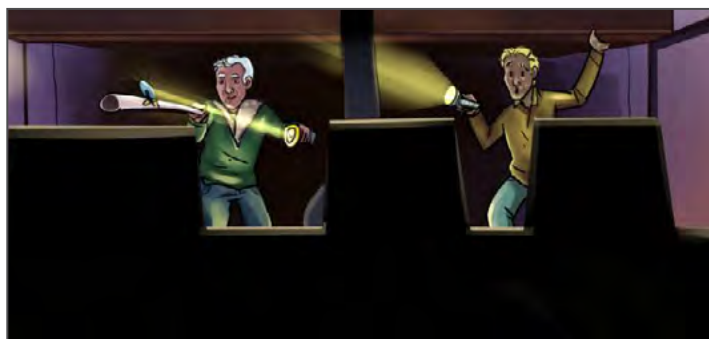
Once in the machine room, Johnny gave the AHU a quick once-over. The unit was laid out in a north-south orientation, close to the west wall of the machine room. Outside air came in through the west wall and was ducted directly to the far side of the mixing box. Return air came from overhead and went to the near side of the box. Mixed air passed through a full-width heating coil and into a double-width-double-inlet fan plenum. At the AHU discharge, the supply duct split west and went down into the slab to the adjacent north zone. The east branch curved down into the slab and went under the AHU to the adjacent south zone. All of the ductwork was heavily insulated.

“The heating coil and control valve are working fine. Just look,” Thatch said, pointing to the gauges on the local control panel. “Coil discharge temperature is right on at 70 degrees. There has to be something wrong with that ductwork between here and the north wing. And we’re going to have to jackhammer up this concrete to figure out what it is. What a pain in the saddlebags that will be!”

As Thatch spoke, Johnny opened the mixing-box damper-access hatch and scanned the dampers with his flashlight. He then motioned to his buddy.

“Thatch, my boy, hand me that yardstick for a second.”

Johnny taped his dial thermometer to the end of the yardstick and held the stick inside the AHU.



“Hey, look, pardner,” Thatch said, exasperated. “We’ve got no time for reindeer games here. You better stand aside because we’ve got some floor to tear up.”

“Whoa there, cowboy,” Johnny said. “Your heating problem isn’t in that cast-in-place sheet metal. It’s in these mixing-box damper blades.

“You’re right in saying your heating coil is working fine,” Johnny explained. “It is working fine, on the average, and the average temperature is all you can read on the control panel because the sensor is an averaging sensor. It senses the temperature all across the coil.

“The problem is, the outside air entering the coil on the far side is a lot colder than the return air entering the coil from the top,” Johnny continued. “The mixing-box control dampers are opposed-blade dampers, which allow for the best control, but the opposed-blade dampers don’t throw the two air streams into each other to promote mixing. The air streams are drawn directly through the coils without much mixing. As a result, the air on the far side is heated to only about 60°F, while the air on the near side is heated to about 80°F.

“These two air streams are stratified as they enter the fan, and they stay stratified through the fan,” Johnny said. “Surprising as it sounds, fans are not air mixers. If the air goes in stratified, it may well come out that way. As it happens, the colder portion of the air stream exits on the west side of the discharge, and the warmer portion exits on the east. The east branch goes to the south zone, and the west branch goes to the north. Hence, your chilly north rooms and cozy south rooms.

“All you have to do is put the brakes on those concrete cutters and get some sheet-metal workers in here instead,” Johnny concluded. “Replace those opposed-blade dampers with parallel-blade types, and mount them to direct the airflows upstream from the coil. By directing the airflows upstream and directly into each other, enough turbulence will be caused to ensure mixing and bring an end to this nasty stratification.”

“Johnny, you’ve done it again!” Thatch exclaimed. “C’mon down to the shop for a cup of jake.”

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# CASE OF THE UNCONTROLLABLE PUMP

At the Montana state capitol, a new VFD is MIA—until, that is, an APB to a certain PE makes everything A-OK.

AUGUST 2017



Johnny Tundra was in the midst of installing a new drain line, part of the perpetual remodel of his Big Timber bungalow, when, as if on cue, the phone rang. It was his college roommate, Hank Hoovestahl, the supervisor of facilities maintenance and operations at the state capitol in Helena. Johnny hadn't seen Hank in months, not since solving the mystery of a leaking boiler relief valve in the Knipple Building. Hank apparently was in another fix. Johnny leaned the piece of PVC pipe against the wall next to his sleeping Basset Hound, Gas Train, and listened to Hank's story.

"The legislature's coming to town next month," Hank groaned, "and the boss says, if I can't figure out why the Rimrock Center isn't saving electricity, my goose is cooked. We spent \$50,000 in taxpayer money for that new variable-frequency drive, and those main pumps aren't doing anything but running just like they were before: full out. In such a big building, that means big bucks.

"I know that VFD is busted," Hank continued, "but the factory technician says it's working fine. If I can't get that pump to slow down, I'm gonna throw that VFD away and start over!"

At 250,000 sq ft, Rimrock Center was the largest building on the capitol campus. Built during the energy-rich 1960s, the structure was a notorious energy hog. About a year earlier, its 50-hp main circulating pumps had been switched over to variable-speed operation to lower electricity use. The heating system, including the pumps, ran 24 hours a day because of data-processing and law-enforcement-dispatch operations.

"Where's the hydronic pressure sensor located?" Johnny asked.

"About 90 percent of the way to the end of the line, just where it's supposed to be," Hank replied.

"Does it work?" Johnny asked.

"Works fine when we take it out and put it in the test jig," Hank replied. "Reads 4 to 20 mA across the range of 0 to 30 ft of head."

"Have you tested it in the pipeline?" Johnny asked.

"The readout at the workstation shows the pressure in the line increasing when the pumps go on and decreasing when the pumps stop, so it looks like it's working," Hank said. "The problem is that, when we take the load off the coils in the building, the pump keeps running at full speed."

"How do you take the load off the coil?" Johnny inquired.

"We manually override the outside-air dampers to fully closed and reset the discharge-air setpoint to 50°F," Hank explained. "That closes the coil valves and reduces the flow from the heating lines."

"Have you actually watched the valves close?" Johnny wondered.

"We've watched most of the valves close, but one is in such a bad location we can't get to it without taking the AHU apart," Hank answered. "But we know the valve is closed because the AHU discharge-air temperature is the same as the air temperature upstream of the coil."



"Sounds like a mystery all right, Hank," Johnny said. "What do you say I put this drain-line project aside for a bit and come on up and have a look-see? Best way to judge a horse is to put your feet in the stirrups, ya know?"

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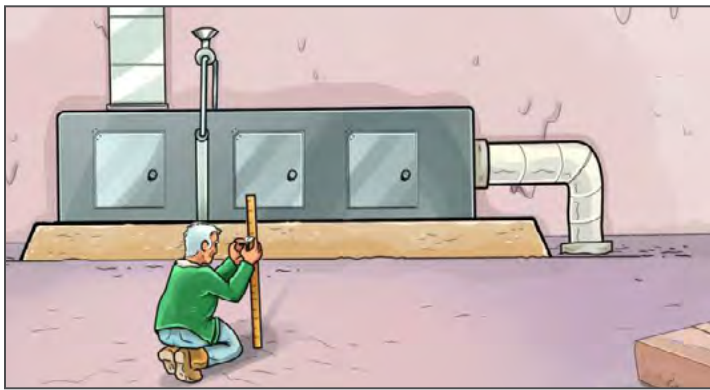
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Three hours later, Johnny steered his 1972 International Harvester Scout into the Rimrock Center parking lot, where Hank was pacing back and forth, agitated.

“What did you do, let the dog drive?” an exasperated Hank said as Johnny and Gas Train exited the vehicle. “You could’ve got here faster by stagecoach! Come on, and take a look at this.”

Hank took Johnny to the basement machine room. Using the building-automation-system workstation, Hank pointed out the two air-handling units located there and demonstrated how he could override the outside-air dampers, reduce the discharge setpoints, and cause the heating-coil valves to close. As Johnny watched, the damper actuators moved to their end points and the valve actuators

moved to their closed positions. Hank closed the valve on one of the AHU coils in the machine room and then the other. He then closed the valve for the remaining AHU, located in the attic.

Hank then turned to the main circulation pumps and the variable-frequency drive mounted on the wall beside them. The readout showed a bright red “60 Hz.” The hydronic circulation pump still was running at top speed.

“Three AHUs in all, eh,” Johnny observed. “Are they all the same?”

“No,” Hank replied. “They’re all different. The smaller ones are about 10,000 cfm, and the big auditorium unit is about 105,000 cfm. The auditorium unit was built into the roof structure and is a bugger to get to. But we know the valve closes when we do the test because of the discharge-air temperature.”

Johnny then went over to inspect the valves on the two AHU coils in the machine room.

“Know any good makes of VFDs?” Hank asked. “Because this one sure isn’t any good. I’m gonna pitch it. What should I use next time?”

“Hold on a minute there, Hankster,” Johnny said. “I wanna go take a look at that big auditorium unit. Bring along that length of conduit, the mirror, and the work light. I have a feeling your problem’s not down in this machine-room VFD, but up in that belfry AHU.”

As the two engineers crawled into the dark, claustrophobia-inducing attic space, Johnny discovered the accessibility of the air-handling unit was worse than he thought. Space for changing filters was poor and access to the coil control valve was non-existent—the valve was on the far side of the air-handling unit, up against the wall, with the height of the space only about four-and-a-half feet.

Using duct tape, Johnny attached the mirror to the end of the conduit and cantilevered the pole to the far side of the air-handling unit. He then plugged in the powerful work light, focusing the beam on the mirror so it reflected down on the control valve. The valve actuator indicated the valve was in the closed position.

“Well, that’s not any surprise to me, pal,” Hank said mockingly. “I told you three times the valve was closed and the VFD is broken.”

“It’s not the actuator I’m lookin’ at, pardner,” Johnny responded. “It’s the control valve itself. What kind of a valve do you see there?”

Hank squinted. “Well, I’ll be—it’s a three-way valve,” he said. “So, it’s bypassing all the flow, and that’s why the pump isn’t slowing down.”

“That’s right,” Johnny said. “When the building was built with the constant-volume pumping system, this three-way valve was put in at the end of the line to make sure the primary circulating pumps could never be dead-headed. All the other AHUs had two-way valves. With the huge flow through this coil, as long as that three-way valve is in place, you’ll never build up enough pressure in the supply pipe to back off the pump.

“All you have to do is replace that three-way valve with the two-way equivalent, and you’re on the road to savings,” Johnny concluded. “Better yet, don’t replace the valve at all; just block off the bottom connection, and convert the valve to two-way service.”

“Sounds like a plan to me, Lone Ranger!” Hank said with appreciation. “Now, let’s saunter over to Big Dorothy’s for that brew I owe you. I’ll even buy a cold one for that hound of yours!”

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# CASE OF THE MYSTERY SUCCESSOR

There's a new HVAC troubleshooter in town — is this farewell to Johnny Tundra?

DECEMBER 2017



Cruising back from the big box DIY store in Billings, Johnny Tundra was making good headway on his perpetual home remodel. The plumbing was in place and the new energy efficient condensing gas furnace was installed. He was still wading through the computer controller instruction manual, but he would get it in time. Maybe.

"Have to make sure those pipe chases are insulated or Eggshell Coggeshell will never let me hear the end of it." He mused. He had stopped a gargantuan energy hemorrhage for Virgil by insulating just such hot water lines and was not about to make the same mistake himself.

Still, something bothered him. In his last phone conversation with Eggshell the facility manager had figured out some way to monitor the vent pipe using the new BAS. It alarmed when the pipe was below freezing and showed a screen indicating current flow through the heat tape. That way he knew the vent pipe was protected. How Eggshell knew to do all that was a mystery, but if that kind of thing continued, Johnny might be out of a job.



"Doggone computerized BAS, anyway. If Thatch (Thatcher "Thatch" McGowan, the facilities manager at Stony End Home for the Aged) had stuck with manual controls he never would have had that mess with the pharmaceutical storage unit cooler," he said to himself.

Back at home he called Jonas "Wooly" Wolcott, just to check in. He had not heard much from any of his hard luck facility managers lately and, despite himself, he was itching to get out and solve some riddles.



"How are you Wooly, is that chiller of yours working OK?"

"Fine and dandy," his buddy replied, "although we ended up rigging a temperature sensor to the BAS to alarm us when the room was warmer than the chiller next door could stand. Now the system automatically starts up at a reduced speed to avoid that high temperature trip."

"You don't say. Everything else OK?"

"Sure," Wooly replied, "since that new control tech came by and set up couple safeguards, haven't had a problem."

"New tech?" said Johnny. "Yeah," Wooly replied, "some newbie just out of MSU. A girl."

"I bet a newbie wouldn't have saved Hank Hoovestahl's bacon when that low head chiller trip had Senator Lester Heappleach after him," Johnny said. "Common sense beats those hi-tech gimmicks every time. I should call Hank and see if he needs any help." And he did just that.

"Hi Hank, how's that chiller working these days?"

"Hi Johnny, good to hear from you again. Fine and dandy, although we did have problems after you left. The guys couldn't find the time to go down there and babysit that 3-way valve every time we wanted to start up the chiller. So this new techie came by and put a temperature sensor in the cooling tower line. Then she rigged the computer to bypass the condenser when the water was too cold. Now the chiller starts up fine, and it's all automatic. We don't have to waste time fooling with it."

“She?” JT said.

“Oh-oh, have to go,” Hank injected. “The vendor is here for the new BAS. Should be a real labor saver.”

“Labor saver my eye. And who is this tech?” JT thought. Twitch Griswold would know. He would never put up with such nonsense.

“Twitch, how’s life treating you?”

“Can’t complain JT, and it wouldn’t do any good if I did,” Twitch replied. “You know, that was real smart the way you fixed those boiler delay switches to keep the pumps running. That stopped the boiler innards from overheating and tripping out the boiler on high temperature.

“But they still zapped out now and then, and we would never know it until it was Monday morning and the place was freezing after the boilers didn’t start. So, we wired the circ pumps up to the BAS and I can see from home that everything is OK.”

“See it from home?” JT said, “how does that work?”

“Simple, Twitch replied. “The BAS has a website and I log onto it just like any other site. I can see everything in the system. That new control tech set it up for me.”



Let me guess,” murmured JT, “the new girl from MSU.”

“That’s right.”

“What’s her name, anyway?” JT inquired.

“Let’s see. Can’t remember. Like a car. Mercury or something...”

“Bothers every day,” the lanky engineer muttered. “Thatch would never stand for that nonsense. Reminds me, I should call and check in about that stratified air damper fix we did last month.”

“Hi Thatch. Just calling to make sure that stratified air bugaboo was put to bed.”

“No problem Johnny. We turned the damper around to mix the air. Even better, that new girl came by and added a mixed air sensor to make sure we get an alarm if it fails. That way the BAS will tell us about the problem before the residents complain and I have the director coming after me with his twelve-gauge.”

“She set it up so that we know exactly what the problem is and can make out the work order without even seeing the air handling unit. That saves me time and gets the job done faster, too. You better look out, I think she’s after your job.”

“Yup, I’ve heard about her. What’s her name? Nobody seems to know.”

“Oh yeah, it’s a funny name. Like a car. Mazda, Mini...No, I know, Mercedes! Mercedes something...”

Johnny decided to call Hank back, thinking he might have remembered the name of this mystery computerized troubleshooter. “Hi Hank. I just remembered about that 3-way valve boondoggle. Did you get it replaced with a 2-way type and start saving some pump horsepower?”

“Sure did Johnny, and the BAS is now monitoring that savings and printing out monthly reports for the boss. Now he gets constant feedback about how much I’m saving the facility and I get constant feedback that the valve is working as it’s supposed to.”

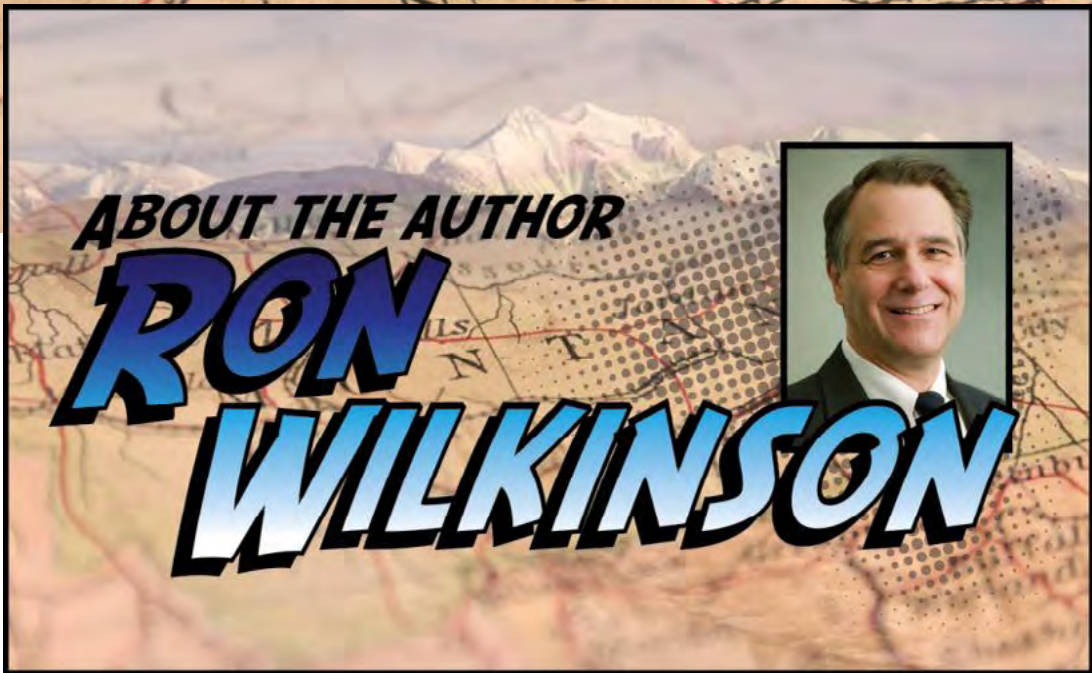


“Let me guess, that new tech girl from MSU set that up for you. Mercedes something?”

“Yeah. Mercedes something. Mercedes, Mercedes ..... that’s it! Mercedes Mercaptan!”

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The founding principal of Seattle-based Wilkinson Commissioning Management, Ron Wilkinson, PE, LEED AP, CPMP, is the author of the first commissioning training program for the Leadership in Energy and Environmental Design (LEED) for New Construction and Major Renovations Green Building Rating System and the founding recording secretary for ASHRAE Guideline Project Committee 0.2/1.2, The Commissioning Process for Existing Building Systems and Assemblies/The Commissioning Process for Existing HVAC&R Systems. An ASHRAE Distinguished Lecturer and an American Institute of Architects Continuing Education Lecturer, he has spoken on commissioning practices internationally. He is a longtime member of HPAC Engineering's Editorial Advisory Board.

Ron is the author of HPAC Engineering's popular series "HVAC in Popular Movies: Did Hollywood Get It Right?"



Ashley Ribblett is a self-described "art nerd" living in Cleveland who "loves drawing anything and everything sweet and surreal." In her free time, she co-runs the Cleveland branch of Dr. Sketchy's Anti-Art School.