ABC'S OF FALSE/NUISANCE TRIPPING

Metal detector manufacturer offers his viewpoint.

By **Greg Balmer**

False or nuisance tripping is the single biggest frustration with metal detection for mill personnel. You can't touch it, see it or smell it so it is difficult to understand the causes let alone affect even a partial cure.

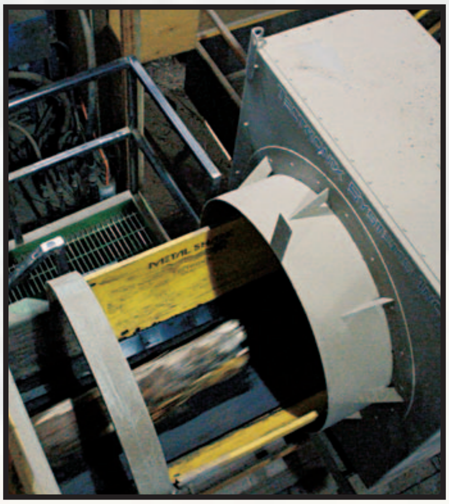
Metal detection is a necessity and a reality in today's modern sawmills. Not only is it a requirement before the logs enter the mill but it is also important to protect secondary sawing operations, the chipper and hog as well as the planer.

There are a number of metal detector manufacturers that continue to use analogue electronics and some of the more advanced utilize a microprocessor. Others claim to have a microprocessor but only use microcircuit boards or a microcontroller and the customer finds out all too soon that the problem of false/nuisance tripping remains all too prevalent. Want to sort truth from fiction? Ask your prospective supplier if his metal detector can mark the *exact* location of the metal in the product being scanned either with an electronic signature and/or by triggering an ink/dye/paint marker to spray a highly visible mark. If the answer is "no," then you need go no further. If their electronics are not capable of performing this simple function then you can be assured that they will not shield against even the simplest causes of false/nuisance tripping such as two-way radios and variable frequency drives.

DDS/DSP/SMT

The latest technology to be adopted by some manufacturers of metal detection equipment is Direct Digital Synthesis or DDS. In simple terms DDS creates a very stable signal that is transmitted to the detection coils and is used as a reference to convert the "receive" signal to a digital format. This allows for higher operating frequencies with rock solid stability. The higher the operating frequency, the smaller the metal the system will find farther from the sensing face. The majority of suppliers of metal detection equipment in the forestry industry today operate their systems at around 15KHz. At these lower frequencies, as a manufacturer, you are able to achieve greater system stability; however, the tradeoff is decreased sensitivity and that is what users have been forced to live with.

Combine DDS with Digital Signal Processing or DSP and you have a metal detector that is just about bullet proof, allowing maximum sensitivity without fear of false/nuisance tripping. Metal detectors are an ideal candidate for DSP as they take a signal from a sensor (a transmitter/receiver coil arrangement) and digitally process it to decide whether or not a metallic contaminant is present. This in itself is a relatively simple task; however, in most cases a contaminant



signal has to be extracted from a much larger signal and within that larger signal is the product signature as well as any mechanical or electrical noise signals. DSP allows for filtering or differentiation of the different signatures or signals so that metal can be recognized for what it is without degradation to the performance of the system.

Now, lets add a third factor to the recipe and that is Surface Mount Technology or SMT. SMT allows manufacturers to use a single circuit board that is very compact, can be multi layered if required but appear to be a single layer, is easy to change out and is self diagnosing. You need look no further than your own personal computer or automobile to find SMT.

To better understand the true benefits of a metal detector that uses DDS, DSP and SMT technologies we first need to digress and outline the major causes of false/nuisance tripping as well as what can be done to minimize the occurrence with non equipped, older systems.

TRIPPING

False/nuisance tripping is truly an industry scourge. It frustrates the user and creates a stigma that all metal detector manufacturers are forced to live with. Unfortunately it has become an acceptable standard when in fact it can be somewhat controlled even with older systems provided you understand the causes and cures.

As anyone who has experienced the effects of false/nuisance tripping with older outdated systems will tell you, the degree or level increases as the sensitivity is increased. If you want to find the smaller nails in logs or the larger metal at the top of the material being conveyed to the chipper or hog, then you have to increase the sensitivity and, bingo, the metal detector has a much higher likelihood of false/nuisance tripping; so in self defense, you decrease the sensitivity and live with more metal than you want getting through the system. A never ending Catch 22.

By design, a metal detector creates or emits an electromagnetic field and when metal enters this field a signal is received and sent to the electronics in the control panel. If the signal is strong enough (the metal is large enough) and the sensitivity level is set high enough, the metal detector "trips." Unfortunately, other factors can also make the metal detector trip. The number one cause is electromagnetic interference or an Electro Magnetic Field (EMF) as it is commonly called. This can come from any number of sources. Two-way radios, variable frequency drives, microwaves, welding, lightning, MCC panels, lighting ballasts and electric motors subjected to intermittent high current/amperage draw such as those found on chippers and hogs can all cause false/nuisance tripping. With a system that has DDS/DSP all but welding and lightning become non issues the majority of the time. These two factors have such a high EMF across the entire range of frequencies that shielding is just about impossible.

Running a close second are Intermittent Closed Conductive Loops or ICLs. Metal to metal contact from broken welds, loose bolted connections, dry bearings, a buildup of dust between a fiberglass section and a metal detector sensing face and static discharge from belts and idler rollers are all controllable factors that can cause false/nuisance tripping.

A dirty ground or AC power supply can also wreak havoc with metal detector electronics, the result of which is false/nuisance tripping. If you treat the metal detector the same as you would your computer and install a filtered UPS (Uninterruptable Power Supply) as well as an independent ground you can be assured these factors will be non issues. A 50 or 60 Hz AC power supply that is unfiltered can have a "hitchhiker" high frequency signal that is guaranteed to cause problems (false/nuisance tripping) and this is far more prevalent than you might think.

Product signature is also a major problem for any metal detector that does not use DDS/DSP electronics. Every product has its own unique signature and if the metal detector can not be taught to recognize this unique signature then it is incapable of differentiating metal from product, the result of which is false/nuisance tripping and the rejection of perfectly good fiber. For example, species such as sugar maple, red oak and southern yellow pine have profoundly different product signatures.

If your logs are harvested from an area with a higher than normal concentration of iron in the groundwater, then this can radically alter the product signature and unless the metal detector has DDS/DSP equipped electronics it can't be taught to ignore this factor. The sugar in maple species, the tannins in red oak and the pitch in pine species, especially southern yellow pine, are highly conductive and can wreak havoc with an electromagnetic field and there is simply no way to teach a "non" DDS/DSP equipped system to recognize these factors and dial them out of the equation.

Moisture, minerals and salts are also factors that contribute to or compound the product signature issue as is log diameter or burden depth. As log diameter or burden depth increases the product signature changes and this factor needs to be recognizable and compensated for by the system. It takes a system with complex algorithms within the DSP to accomplish this and it is very proprietary technology with only a small number of companies having authorship. Beware of systems that offer "reduced product effect." Reduced from what? This tells you nothing and can not deliver what you need. Systems that can be taught to ignore or zero out *all* product effect are where technology is at.

Mechanical noise in the form of vibration can also cause false/nuisance tripping. Systems that have DDS/DSP electronics are required to be hard mounted to the support structure as they can be taught to ignore a level of vibration whereas older systems are mounted on isolation donuts or pads for the obvious reason. Since vibration is a fact of life in a mill, you want to make sure you go the extra mile with your support structure if you already have or plan to have one of these older systems. Although severe vibration or shock loading can also be ignored through the "teach" process with DDS/DSP equipped systems, the tradeoff can be decreased sensitivity as the filters within the electronics have to concentrate or focus on this single factor; so it is a good idea to ensure your support structure is independent and firmly anchored.

For whole log systems, aperture shape and size can also contribute to false/nuisance tripping as can the type of material the metal detector housing is constructed from. A large rectangular or square aperture metal detector that is non DDS/DSP can capture more electronic noise and is more likely to false/nuisance trip. A hexagonal or octagonal shaped aperture is less likely to capture as much noise depending on how large the aperture is; however, a round aperture is the best shape as it offers the least open area when compared to log size/diameter.

If you think of the aperture of a metal detector as an antennae and use the analogy that the larger the aperture the greater the antennae effect, you can appreciate the need to have the aperture as small as possible for the largest piece you want to scan. Each of the four corners of a rectangular and square aperture metal detector are wasted when it comes to their ability to sense metal. They are simply too far from the product the majority of time so your sensing field is limited.

Some manufacturers now offer an Electro Magnetic Field Shield or EMF Shield as an integral part of their design/deliverables. Systems equipped with these shields are easy to spot. The metal detector housing has a shield that protrudes approximately 12 in. (300 mm) from each side of the housing and these shields are designed to encapsulate the electromagnetic field generated by the metal detector coils. The big benefit here is a very short Metal Free Zone or MFZ. Mills that are short on space can consider one of these systems. The material that is used for the housing is also a critical factor. Stainless steel and aluminum are by far the best with ferrous a distant second. This external skin helps to shield the unit even if it is DDS/DSP/SMT equipped. Other materials such as fiberglass or composites offer no external shielding whatsoever and are therefore far more susceptible to false/nuisance tripping.

Troubleshooting can be a relatively difficult process especially if there are multiple causes. One method that is proven to work is to make sure the entire mill is shut down with only the metal detector powered up. Set the sensitivity as high as possible, then in an ever increasing circle start/power-up other equipment making sure you note any movement on the bar graph/screen or LEDs on the control panel. If any of the equipment is causing a problem it will be quite evident. If the unit "trips" then you have found the culprit. If you are diagnosing a whole log system it is a good idea to leave starting the belt conveyor until last. If the belt is contaminated with metal or there are ICLs from idler rollers or dry bearings you will be able to isolate these as the cause of the false/nuisance tripping. Remember, there may be more than one cause.

With the advancements in technology in the last two years about 95% of false/nuisance tripping can be dialed out or "learned" by metal detectors equipped with DDS/DSP/SMT electronics. This is truly a quantum leap forward in metal detection technology especially when you consider the stability and reliability factors. These systems are sophisticated enough that metal of a certain size or mass can be dialed out or learned by the system. The key here is that it must always be the same distance from the sensing face in the product being conveyed. For example, if you have a vibrating or belt conveyor feeding a chipper or hog and you want to ignore smaller metal that is a given distance from the sensing face of the metal detector, you can teach the system to do so. TP

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