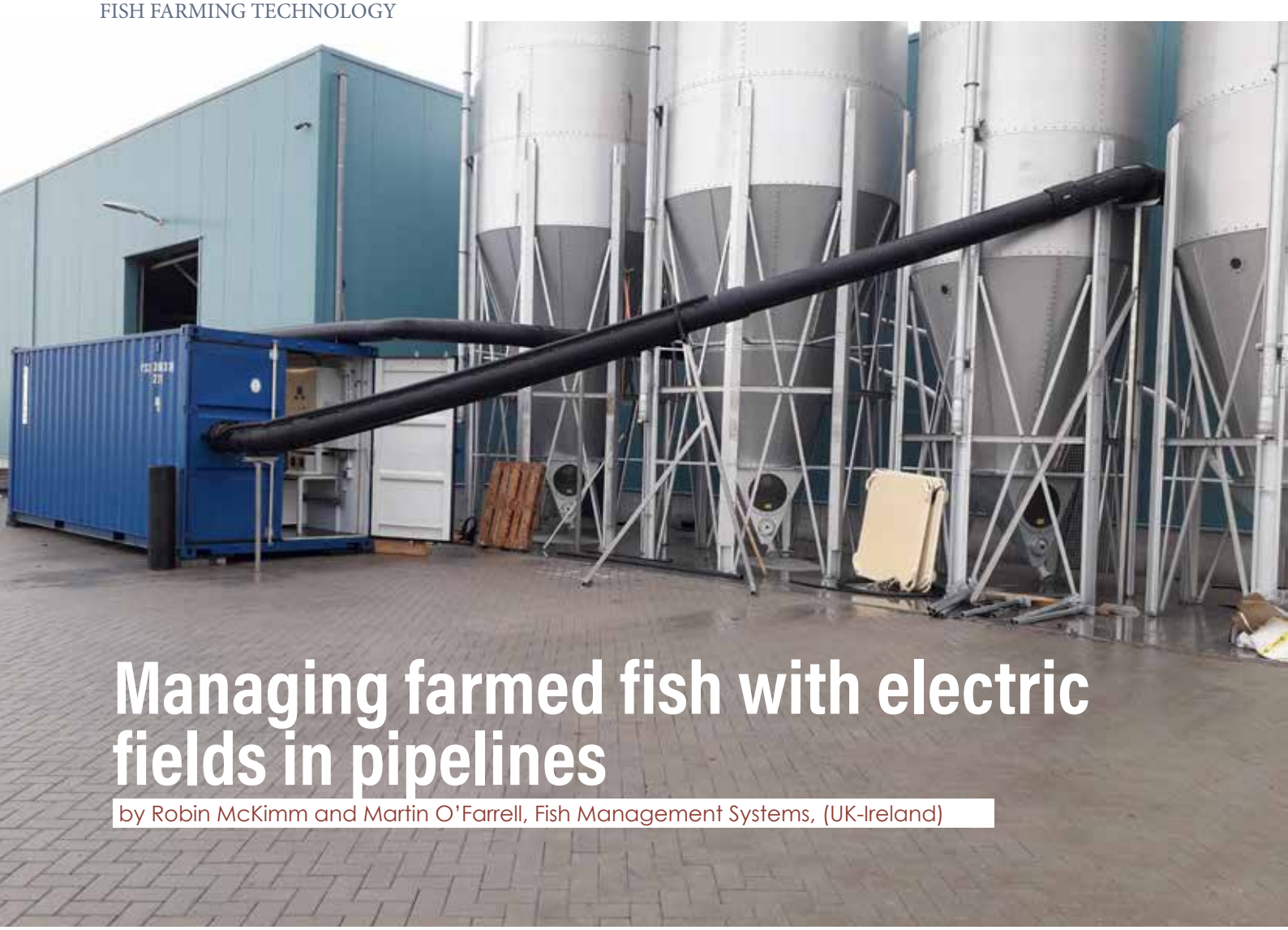

# Managing farmed fish with electric fields in pipelines

by Robin McKimm and Martin O'Farrell, Fish Management Systems, (UK-Ireland)

**"Many fish farmers are concerned about the fish harvest methods they deploy"**

**A pest control business known to us has an introductory paragraph which reads, 'most people don't think about pests, but when they discover that they have a pest problem in their home, they can think about nothing else'. In the world of aquaculture, a similar concentration of the mind applies to fish harvest methods. Many fish farmers are concerned about the fish harvest methods they deploy. They know that regulators and society in general, as represented by the consumer, are concerned, and they know they must do better! Their fish deserve better.**

We have attended many aquaculture tradeshows throughout Europe and the USA and, during discussions at our booth, we meet aquaculture managers who tell us how they are currently harvesting fish. They describe batch electrical systems deploying AC electric fields where several minutes of operation are

required to ensure that every fish in the batch is dead. They know they need to improve on harvest practice because their harvested fish have a high percentage of bloodspots.

They also know that regulatory authorities and the consumer will not continue to ignore harvest practices which fail to meet humane standards. They also understand that poor handling/harvest practices during the last minutes of fish life are compromising their good husbandry practices from egg to harvest time. And they inform us about their experiences e.g. operators of percussion stunners complain that up to 30 percent of the fish are not correctly stunned before bleeding/operators of dry-electrical stunners state that up to 7 percent of the fillets have bloodspots.

In the world of wild fish management in freshwater environments, the generation of electric fields in water has long been a useful tool in the non-destructive capture of fish for scientific study or selective removal from water bodies (electrofishing equipment) and also in the blocking/guiding of upstream/downstream migrating fish and the exclusion of invasive fish species (electric fish barriers).

Waveforms used in electrofishing equipment and electric fish barriers are typically direct current (DC) and/or pulsed direct current (PDC). The deployment of AC electric fields in water has long been discontinued for such purposes in most parts of the world due to the danger posed to fish wellbeing and operator safety.

It is well known, from a multitude of scientific papers, that AC electricity physically damages fish, internally and externally, yet in-water and dry-electric fish stunners still use this waveform

during farmed fish harvest operations. It is also known from those same sources that the fish must be maintained in the stun field for more than three seconds, more likely eight seconds for non-recovery, before being killed by another method e.g. bleeding. Assuming that fish are being pumped at 1.5m per second, that equates to a 12m long pipeline to do it properly, or 4.5m long pipeline at an absolute minimum.

To overcome the latter short recovery period the applied voltage must be increased to hit the fish harder. Higher applied voltage means even more fish damage and more power requirements, which increases as the square of the voltage. Higher voltages not only stress the power supplies but increase the chance of stray voltages and currents, which needs to be avoided to protect human operators. Some of these devices have, surprisingly, won awards although their designs contradict academic, practical and production evidence.

We took note of those academic papers, and, in particular, the wild fishery papers which plead for a ban on AC electric fishing and we, at Fish Management Systems, have produced a device which does not use AC electricity in the water. The result is a pipeline which is longer but incorporates low voltage reliable power supplies, runs at relatively low power and has fully controllable waveforms. These all lead to a harvested fish which is free of damage and which now obtains the best market price.

The electric, in-line, in-water, pipeline fish management technology, developed by Robin McKimm at Fish Management Systems can operate at water conductivities ranging from 20 $\mu$S/cm – 55,000 $\mu$S/cm (full strength seawater). As the electric fields are controllable, the same device can be used at low settings for grading and vaccination purposes and at higher settings during harvest operations. Two systems have been developed as follows.

Firstly, an in-line, in-water, stun-kill system (SKS) has been developed for the harvest of portion sized farmed fish. At the time of harvest, fish are pumped from net-pens/raceways/tanks and pass through a convoluted pipeline which is approximately 100m long. This pipeline is typically mounted on a frame and occupies a footprint which is 11.5m long x 2.6m wide x 2m high. On entry into the pipeline, the fish are rendered senseless in less than one second. The fish continue their passage through the pipeline, which takes about 90 seconds, during which time the electric stun is maintained and the fish die of anoxia.

A de-watering tower separates the fish from the water as the harvested fish exit the pipeline and are collected in suitable containers for delivery to the processing plant. Systems have been in operation in Scotland for a number of years, during which time an estimated 10 million farmed rainbow trout, averaging 500g, have been harvested. The system is capable of processing 10,000 fish (five tonnes) per hour. Less than one percent of fillets from this harvesting process have exhibited blood spots (haematomas) and companies using the technology have been awarded RSPCA Assured Certification by the Royal Society for the Prevention of Cruelty of Animals (RSPCA).

Secondly, an in-line, in-water, fish management system (FMS) has been developed, which is suitable for fish transfer activity, fish vaccination, fish grading and electric stunning at the time of harvest. Fish are pumped from net-pens/raceways/tanks and pass through a pipeline which is approximately 16m long. The electronic equipment and some of the pipeline are typically housed in a 6.2m long container. The 10m of pipeline outside the container can be installed to suit the space available for the system.

When the FMS is used to electrically stun fish prior to slaughter (bleeding), the fish are rendered senseless in less than one second after entry into the pipeline. The fish continue their passage through the pipeline, which takes about 15 seconds, during which time electric fields maintain the stun, which lasts for up to four minutes after fish exit the pipeline. A de-watering tower separates the fish from the water as the harvested fish exit the pipeline and are collected in suitable channels for bleeding etc. The system can process approximately 4000 –8000 fish per hour (depending on size) and, in accordance with the pipeline diameter selected, fish up to 7kg can be processed.

Where the system is used for fish transfer, fish grading or sea lice removal, lower intensity electric fields are deployed to calm/mildly sedate fish to facilitate the desired fish management procedure. A system is currently being used in full strength seawater to grade yellowtail kingfish while another system is being trialled for Atlantic salmon sea lice control.

The electronic technology, has proven successful everywhere systems have been commissioned. The systems have been developed with the assistance of selected aquaculture companies and with very little state / institutional support. We can also state that our SKS and FMS are in regular use and perform as expected. None of our commissioned SKS or FMS installations are lying idle or perhaps used occasionally during audits. We have not competed for any prizes and we have not copied any other product.