Details of the 2025 / 2026 sheep restoration

This is report revision 0 written February 2026 by Dave Cranmer of Nervous Squirrel Ltd, who was asked to investigate and repair the sculpture, and also re-design and document the control system with a view to making it easier to maintain in future.

The sculpture was found to be generally exceptionally well built, with mechanical and electrical failures due to long term wear rather than design flaws.

Specific parts found to have failed included:

- Snapped cable for the sheep tip mechanism
- Split / leaking hydraulic hose
- Failed 9V toroidal transformer (meaning no power to wolf and sheep)
- Non-functioning rotary drive to wolf hands
- Broken bracket connected to wolf head rotate
- Halogen bulbs blown in floodlights

Other parts that needed attention included:

- Weathered paint
- Tarnished metal surfaces
- Rusty / stained areas
- Missing pop rivets
- Wiring in very poor condition within sheep and wolf
- Missing wolf tongue
- Damaged sheep leg
- Various labels on switches and buttons inside control box either corroded or fallen off.

A cache of nuts within the sheep was also removed, presumably left by a small animal. Or gallery technician?

It wasn't possible to test the original PLC in situ, as the failure of other elements prevented testing. The intention was always to replace the PLC anyway.

There were a number of loose wires in the control box, although it wasn't clear whether these were due to accidental damage or untidy legacy modifications.

Again, the sculpture was found to have been built skilfully and robustly, but certainly benefitted from a refurbishment after a quarter of a century outdoors.

Further resources

Visit this link to download all documentation of the project:

www.nervoussquirrel.com/sheep_documentation

The page at the link above has current (February 2026) documents, including:

- Wiring diagram
- Control box component diagram
- Arduino code
- Sheep audio file
- This report

Work carried out

Control

• PLC replaced with new arduino and relay system.
• Spare control box created with deutsch connectors for easy swapping.
• New code written for arduino system.
• 24 hour timer re-programmed.
• Failed 9V toroidal transformer replaced with new significantly more powerful power supply.
• Elderly 24V transformer replaced with new significantly more powerful power supply.
• Obsolete wiring removed.
• Legacy umbilical control box removed and replaced with new manual switching system.
• All electronics removed to vacuum and clean detritus from control box.
• New crimps fitted where necessary.
• General re-wiring of everything that needed it.
• All DIN rail mounted components tested.
• New cable trunking.
• Obsolete connections removed (smoke machine, old lights, mysterious cables not connected to anything).
• Provision to control new LED flood lights added.
• New 16MB audio playback system.
• New amplifier connected to speaker in the porch below the balcony.
• Magnets used to mount anemometer, umbilical box, amplifier and amp PSU so that the waterproof enclosure didn't have to be drilled.
• Rubber plugs in old fixing holes.
• New cable glands fitted in base of control box.
• Anemometer connection re-housed in new waterproof aluminium enclosure.

Wolf

• Head removed for service. Neck shaft cut as shaft rust wouldn't pass through bearings.
• Loose motor in head bolted back in place.
• New tongue (static) modelled. Old tongue and mechanism were entirely missing.
• New tongue mechanism considered, but existing motor emits smoke and access is restricted.
• Wiring and cable protection to LED eyes replaced.
• Shaft coupler added to rejoin head and facilitate access in future.
• Hands removed and flexible drives serviced.
• Grub screws in flexible drive collar connections tightened.
• All mechanism linkages cleaned and oiled where required.
• Reciprocating head bracket welded (it had snapped off).
• All wolf wiring and distribution box completely removed and replaced with new loom.
• Bracket fabricated to hold new distribution box.
• Multi core cable fitted with inline deutsch connector to facilitate future maintenance.
• Wolf body cleaned and repainted in RAL8104 sepia brown plus black and white spray paint detailing.

Sheep

• Aluminium body cleaned with pressure washer and polished with abrasive cup brush and cold water.
• Frame and copper components cleaned with pressure washer, brake cleaner and scotchbrite pad.
• At least 20 missing pop rivets replaced.
• Dangerous / sharp zinc spikes from original galvanising process filed off where discovered.
• Rusty parts painted with hammerite silver paint.
• Legs repaired with Isopon P40 and car body filler.
• Legs painted with etch primer and satin black spray paint.
• New M6 nylon fixings to re-attach aluminium body parts.
• New M25 washers on hydraulic ram fixings.
• Corroded fixings replaced with stainless steel fixings where necessary.

Hydraulics etc.

• New steel rope and fixings for sheep tip mechanism.
• New hydraulic hose to replace the old one that had split.
• New rubber pads and fixings on "crash landing" system.
• New LED flood lights to replace old halogen lights.
• Smoke machine disconnected from system.
• Cable management where necessary.

Potential improvements for next time the sheep receives a major restoration

• Replace flexible drives to hands, and possibly the corresponding motor and linkages.
• Replace the linkages that drive the sheep's feet, and possibly the wiper motors.
• Consider replacing the motor that drives the wolf's head.
• Consider making an animatronic tongue mechanism.
• Polish the sheep's body, then get it powder coated with a clear coating to prevent further oxidation. It might also be possible to do this with the copper components (head, ribbon etc.)

Troubleshooting

The idea behind troubleshooting an electromechanical sculpture like this is to first of all identify where the source of the issue lies, i.e is it the control box, something mechanical, or the communication between the two.

No movement at all

Is the 230V power switch over by the hydraulic pump turned on?

Is the main power switch on the metal control box switched on?

Check whether the 24 hour timer is set correctly. Is it showing the correct time? Does the LCD display show the word "ON" when the sequence starts at 2 minutes to the hour? Has the sliding switch been set to "AUTO"?

If the timer is activating properly, its built in relay should turn on the amplifier, the anemometer and the arduino power supply. Are these showing power indicator lights?

If the arduino is on and the relay boards within the inner enclosure are functioning, you should hear them clicking through their sequence, and see the LEDs next to the relays lighting up in turn.

Is it too windy? The sheep won't deploy if the anemometer detects wind over the level set on the dial.

There is a connection from the hydraulic pump contactor (big relay) to the arduino, which detects if the contactor has been overloaded and prevents the automatic sequence from proceeding. This error should be fairly easy to identify as the hydraulic pump won't be switching on at the beginning of the sequence. The arduino will also rapidly click the spare unconnected relay 20 times to indicate this situation has been detected. The system also clicks the spare relay 20 times when it's currently too windy on the balcony.

Is the 24V power supply working? It has a green LED power indicator that should be on all the time. If the 24V power supply fails none of the mechanical aspects will activate as this supply is required to drive the relays.

Are the circuit breakers all on? If one or more has tripped, proceed with caution as an issue elsewhere has caused this to happen.

Are all the switches on the umbilical box in the up position, i.e. switched off? If any of the 5 switches are on, the system will enter manual mode and the automatic sequence won't run.

Have all the deutsch connectors been properly pushed in on the side of the arduino box? Has the powercon connector been fitted correctly? The powercon connector is the blue plug, which needs to twist and click.

Is the hydraulic pump running as expected at the beginning of the automatic sequence?

Are the hydraulic valves operating? Test connections with a multimeter or listen for clicks.

Is there hydraulic fluid squirting through the air in glorious abandon onto the public below the balcony?

If the wolf doesn't move, or if the sheep's legs don't move

• Check the 9V power supply - it has a green power LED that should be on constantly. If the 9V power supply fails, the sheep won't move its legs, the wolf won't move, and the wolf's eyes won't light up.
• Check the circuit breakers.
• Check the automotive fuses in the lower RH side of the control box. If any have blown, investigate the potential cause before replacing them.
• Check for damaged, jammed or disconnected mechanisms and linkages.

If the sheep doesn't tip up

• Check the steel rope connected to the rear of the sheep.
• Check the rope passes freely around the pulley at the front of the balcony.
• Check the associated hydraulic ram that pulls the steel rope.
• Check the associated hydraulic valve.

If there isn't any audio playback

• Check the amplifier is turned up.
• Check the amplifier is powered (it has a 19V power supply attached to the top of the control box with magnets).
• Check the connection to the speaker in the porch below.
• Check the red LED on the adafruit board lights up during the automatic sequence.
• Check the file on the adafruit board isn't corrupted and is in the right format, particularly if it has just been updated.
• Using a jumper wire from trigger pin 0 to GND should trigger the audio file playback for testing.

No flood lights

• Check circuit breakers.
• Check relays.

Maintenance

The key to maintaining the sculpture is to schedule a particular time for a technician to watch the sculpture run through its sequence. At least once a week, perhaps on a Monday morning or a time that works as part of a routine. Ideally every day: make a coffee and go and watch the sheep at 11am.

The technician should be familiar with the sequence, and respond to any non-standard behaviour. In time the process will become subconscious, like knowing a classic car is running well from the sound it makes.

It seems that before the 2026 restoration the sculpture was left to operate continuously even as various parts failed. There is a video online of the wolf emerging facing downwards, the sculpture clearly having been left to run even after the steel cable for the tip mechanism had snapped.

Catch malfunctions early and they won't escalate, and the sculpture can continue to run in all its magnificence.

The 9V and 24V power supplies are on constantly, and will likely fail over time as their internal fans wear out. Their failure won't cause any harm, they'll just cause things to stop. Treat the power supplies as a consumable - they are cheap to replace and won't take long to swap.

To remove the power supplies: disconnect their wiring, then unscrew the plastic board onto which they are mounted. The screws for the power supplies are on the underside of the plastic mounting board. Replace with a power supply with the same specifications for voltages and current ratings. Check the wiring diagram if unsure of connections.

Check the level of the hydraulic fluid every 6 months, and check for leaks.

Change the hydraulic fluid every 3 years.

Change the oil filter every 3 years.

Establish a rota to determine who is responsible for these checks, and keep a record of who has done the maintenance.

Arduino code

See www.nervoussquirrel.com/sheep_documentation

The code for the arduino nano in the control box can be downloaded from the link above. The code is currently version 34, named "sheep_34", as left in the control box Feb 24th 2026.

Alternatively, get a work experience kid to meticulously type out the following:

```
// February 24th 2026

#include <avr/sleep.h>

const unsigned long debounceDelay = 50;

bool lastButtonReading;
bool buttonState;
unsigned long lastDebounceTime = 0;

bool manualMode = false;   // Decided once at startup
byte stopSheepSequenceBecauseItsTooWindy = 0;

const int hydraulicMotorContactor = 2;
const int hydraulicValve1 = 3; // Gantry valve
const int hydraulicValve2 = 4; // Cable valve
const int hydraulicValve3 = 5; // Sheep open valve
const int hydraulicValve4 = 6; // Manifold valve

const int spareRelay = 7;
const int relay1 = 12;
const int relay2 = A0;
const int relay3 = 8;
const int relay4 = 9;
const int relay5 = 10;
const int relay6 = 11;
```

```
const int contactorErrorDetectPin = 13;
const int switchPins[5] = {A1, A2, A3, A4, 0}; // CHANGE ORDER TO MATCH VALVES!

const int anemometerSwitch = 1; // Permission to proceed from the anemometer
const int adafruitTrigger = A5; // Play audio file

const int hydraulicRelayPins[5] = {
  hydraulicMotorContactor,
  hydraulicValve1,
  hydraulicValve2,
  hydraulicValve3,
  hydraulicValve4,
};

const int otherRelayPins[7] = {
  spareRelay,
  relay1,
  relay2,
  relay3,
  relay4,
  relay5,
  relay6,
};

// - - -
```

```
manualMode = isHandsetActiveAtStartup(); // Check for activated switches on the umbilical handset

  if (!manualMode) { // If the handset hasn't been activated
    runAutomatedSequence();
    stopForever();  // Stop forever after running sequence
  }
}

void loop() {
  // - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - LOOP:
MANUAL MODE

  if (manualMode) { // Manual mode runs forever if it has been activated
    for (int i = 0; i < 5; i++) {
      int switchState = digitalRead(switchPins[i]);
      digitalWrite(hydraulicRelayPins[i], !switchState); // Make a switch input pin that's low into a relay output pin
that's high, i.e. invert the state.
    }
  }
}

// - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - SWITCH
CHECK ON STARTUP

bool isHandsetActiveAtStartup() { // Check whether any of the switches on the umbilical handset have been
activated
  for (int i = 0; i < 5; i++) {
    if (digitalRead(switchPins[i]) == LOW) {
      return true;
    }
  }
  return false;
}

// - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - AUTOMATED
SEQUENCE

void runAutomatedSequence() { // 24 hour timer switches on power to arduino at 2 minutes to the hour

  digitalWrite(relay1, HIGH); // Floodlight 1 on
  digitalWrite(relay2, HIGH); // Floodlight 2 on

    delay(60000);  // Allow anemometer wake-up

    unsigned long startTime = millis();

    while (millis() - startTime < 60000) {

      if (digitalRead(anemometerSwitch) == LOW) { // If the anemometer has detected high winds within the 1
minute window
```

```
      digitalWrite(relay1, LOW); // Turn off the floodlights
      digitalWrite(relay2, LOW);
      for (int x = 0; x < 20; x++) { // Flash the spare relay 20 times as a warning indicator
        digitalWrite(spareRelay, HIGH);
        delay(100);
        digitalWrite(spareRelay, LOW);
        delay(100);
      }
      return; // Too windy → exit sequence
    }
  }

 // - - -
```

```
  digitalWrite(relay4, LOW); // Stop sheep legs
  digitalWrite(relay5, HIGH); // Wolf claws

  for (int x = 0; x < 5; x++) {

    digitalWrite(relay6, HIGH); // Wolf head rotate
    delay(3000);
    digitalWrite(relay6, LOW); // Wolf head stop
    delay(1000);
  }

  digitalWrite(relay5, LOW); // Stop claws

  digitalWrite(hydraulicValve3, LOW); // Close sheep
  delay(20000);

  digitalWrite(hydraulicValve1, LOW); // Gantry descend
  digitalWrite(hydraulicValve2, LOW); // Release cable tilt
  digitalWrite(relay3, LOW); // 9V wolf eyes and 0V off
  delay(20000);

  digitalWrite(hydraulicValve4, LOW); // Manifold valve off
  digitalWrite(hydraulicMotorContactor, LOW); // Hydraulic pump off
  digitalWrite(relay1, LOW); // Turn off the two floodlights
  digitalWrite(relay2, LOW);

  // Automated sequence stops forever at this point, 24 hour timer will cut power
}

// - - -
```