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Case No: HT-2022-000079

IN THE HIGH COURT OF JUSTICE
BUSINESS AND PROPERTY COURTS OF ENGLAND AND WALES
TECHNOLOGY AND CONSTRUCTION COURT (KBD)

Royal Courts of Justice
Rolls Building, London, EC4A 1NL

Date: 2 September 2024

Before :

Jason Coppel KC
(sitting as a Deputy High Court Judge)

Between :

MAGNETIC SHIELDS LIMITED

Claimant

- and -

**VACUUM AND ATMOSPHERE SERVICES
LIMITED**

Defendant

Nicola Atkins (instructed by Brachers LLP) for the **Claimant**
Gideon Shirazi (instructed by George Green LLP) for the **Defendant**

Hearing dates: 14-16 and 20 May, 10 June and 2 September 2024

Jason Coppel KC:

The Claim

1. A vacuum furnace is a substantial piece of equipment used in the manufacture of metal and ceramic products. The contents of the furnace are heated to very high temperatures in a vacuum, air having been removed from the furnace chamber. This protects the contents from oxidation, contamination and other potential side effects of the heating process. The contents are then cooled, or quenched, using an inert gas such as nitrogen. The purpose is to alter the properties of materials, such as their strength, ductility, toughness and hardness. Depending upon the desired manufacturing process, a vacuum furnace may be a positive pressure furnace, pressurised to pressures above atmospheric pressure, or a negative pressure furnace, where the pressure is less than atmospheric pressure.
2. The Claimant (“**MSL**”) owns and operates a number of vacuum furnaces across multiple manufacturing sites. In June 2017, MSL acquired two used vacuum furnaces, one of which was an Abar HR50 furnace (“**the Abar**”), originally built in the 1980s and designed to operate at pressures up to a positive pressure of 5 bar absolute.¹ In November 2017, MSL engaged the Defendant (“**VAS**”) to refurbish the Abar to an “as new” standard specification (and, separately, to refurbish the other furnace bought alongside the Abar (“**the CVE furnace**”). The operation of the Abar is controlled by a Programmable Logic Controller (“**PLC**”) and a new PLC was to be supplied as part of the refurbishment.
3. The Abar was refurbished on VAS’s premises in West Bromwich, before being installed and commissioned at MSL’s premises in Staplehurst from October 2018 onwards. Certain difficulties arose during this process, but it was completed to the apparent satisfaction of both parties and the Abar entered into service for MSL in October 2019.
4. On 15 June 2021, a serious incident occurred during the operation of the Abar. During a negative pressure cycle, where the PLC was set so that the pressure of the Abar would not exceed atmospheric pressure of 1 bar, pressure unexpectedly reached 3 bar. When steps were taken to reduce the pressure in the Abar, in accordance with an operating manual provided by VAS, by opening its “Air Admit Valve”, a filter was ejected from the air admit outlet at speed, striking a wall approximately 8m from the Abar. Clearly, all was not well with the Abar, and MSL stopped using it whilst investigations were undertaken into the cause and remedy of what I will refer to as the overpressure incident.
5. MSL commissioned a competitor of VAS, Vacuum Furnace Solutions (“**VFS**”), to assess the safety of the Abar and recommend any appropriate

¹ In this judgment, all pressures are given as “absolute” pressures, where 1 bar is atmospheric pressure, as opposed to “gauge” pressures, which start from a baseline of atmospheric pressure and are 1 bar below absolute pressures.

modifications. Following visits to MSL in July and August 2021, VFS compiled a report on 3 September 2021 listing a number of problems it had identified and the necessary remedial works, which it costed at £12,850 (“**the VFS report**”). Certain of the works could require a modification to the PLC’s software, but VFS noted that it had not been given full access to that software and entered caveats both that the cost of the remedial works could be reduced if the software issues turned out to be less serious than it had surmised, but also that further issues might emerge once it was able to fully test the operation of the Abar.

6. VFS was not commissioned to carry out the works it had recommended. Nor did MSL insist that VAS did so, either pursuant to the terms of a two year warranty which had been offered with the refurbished Abar or otherwise. The Abar has remained out of service ever since the overpressure incident and indeed MSL purchased a brand new furnace in May 2022 to carry out much of the work which the Abar had been intended to perform.
7. On 14 March 2022, MSL issued proceedings against VAS claiming damages – which are now put as being for breach of contract only – arising out of the allegedly defective refurbishment of the Abar. As originally pleaded, its claim was for the costs of essential repairs identified by VFS (£12,850) and the cost of replacing the Abar’s PLC (£74,000) (without any explanation of why this was necessary) alternatively the full cost charged by VAS for refurbishing the Abar, including supply of a new PLC (£199,015) (without explanation of why it would be necessary to start the refurbishment from the beginning). In addition, MSL claimed the additional costs, characterised as staff overtime costs, caused by running other furnaces in order to perform the work which the Abar had been intended to do.
8. VAS initially failed to acknowledge service and MSL applied for judgment to be entered. I apprehend from the first witness statement in the proceedings of David Woolger, the Managing Director of MSL, which was filed in support of that application, which dealt almost entirely with quantum matters, and offered to accept £199,015 to resolve its claim, that MSL expected a speedy resolution of the dispute. Regrettably, no such resolution was achieved, and the claim reached trial just over two years after issue, taking approximately five days of court time, during which I heard oral evidence from four witnesses on each side and three experts, Mr Camplin (on mechanical engineering issues) and Mr Heath (on electrical engineering issues) for VAS and Mr Barraclough (on all engineering issues) for MSL. The value of the claim, although reformulated by MSL in an “Updated Schedule of Loss”, continues to range from as little as £12,850 (or indeed less, as VAS argues that there should be some discounting from VFS’s quotation) to the full cost of refurbishment charged by VAS (£199,015), with now additional costs totalling £78,543.17 arising out of the operation of other furnaces, the continued maintenance of the Abar, the engagement of VFS and the costs initially incurred by MSL in taking delivery of and installing the Abar.
9. In this judgment I shall address first the question of which contractual terms applied between the parties. There was a dispute as to whether the contract for refurbishment of the Abar (“**the contract**”) was on MSL’s standard terms and

conditions of business or those of VAS. There was also an important dispute between the parties as whether the contract had been varied to the effect that the Abar was not to be commissioned by VAS to its original, 5 bar, specification but only to work as a negative pressure furnace, at 0.8 bar pressure. I shall next consider in turn the list of defects in the refurbishment works which are relied upon by MSL, before turning to causation of loss and quantification of damages. There are also two counterclaims brought by VAS seeking payment of unpaid invoices which I shall address last.

The contractual terms

10. VAS issued a detailed quotation for refurbishment of the Abar (described as the “Abar HR50 6bar OPQ Vacuum Furnace”) on 31 October 2017. Refurbishment was to be “to a **NEW** standard” (emphasis in original). 25 items were listed. Items 1-22 and 25 listed various components of the Abar which were either to be replaced (such as a “hot zone”, graphite heater set, hearth assembly and PLC) or refurbished (such as pumps, a fan motor and a transformer). Item 23, valued at £4860, was commissioning and testing of the Abar, including a Temperature Uniformity Survey. Item 24 was the provision of a new operation manual and drawings. The total cost was £199,015. Payment terms were 30% with order placement, 60% on delivery and 10% “on completion”. No mention was made in the quotation of VAS’s standard terms and conditions of business. Under the heading “Conditions of contract” it referred only to a “24-month warranty excluding consumables” which was offered by VAS.
11. On 2 November 2017, David Woolger of MSL emailed VAS to say that he was happy with the quotation and would raise a purchase order for the work. He sent a purchase order on 9 November 2017 (“**the PO**”). This was for refurbishment of the Abar “*as per the items detailed below, in accordance with your quotation dated 31 October 2017*”. The PO then substantially repeated the 25 items from the quotation. There were certain differences in the formulation of the 25 items, including the omission of what may have been regarded as unnecessary explanations. The PO repeated the payment terms set out in the quotation, save that the final 10% was to be payable “on completion of testing”. Each page of the PO made reference to the MSL’s terms and conditions which were said to be available on its website or on request. VAS characterises the PO, correctly in my judgment, as a counter-offer.
12. On 10 November at 15.37, Mark Smith of VAS emailed Mr Woolger thanking him for his PO and stating that he attached VAS’s order confirmation and would shortly forward an invoice for the first tranche of payment. In fact, that email only attached MSL’s PO and Mr Smith emailed again at 15.38 with the same text but this time attaching both the PO and VAS’s “Sales Order”. The Sales Order stated that it was for refurbishment of the Abar “Order to cover all 25 items listed on VAS [sic]” and set out the payment terms, with “10% of order value on confirmation”. No reference was made in the Sales Order to VAS’s standard terms and conditions. At 15.44 on 10 November 2017, Mr Smith emailed an invoice to “Sarah” in MSL’s accounts department. This contained the same description of the transaction as in the Sales Order save

that it stated “Order to cover all 25 items listed on VAS Quotation 10568B”. A box in the bottom left hand corner of the Invoice stated:

“Payment Terms:- Strictly 30 days from date of invoice, Total Net Amount £ 59,704.50 unless otherwise agreed in writing. The goods detailed on this invoice remain the property of Vacuum & Atmosphere until full payment is received, by Vacuum & Atmosphere, for said goods. For full details please refer to Vacuum & Atmosphere Services terms and conditions, which are available on request.”

13. In my judgment, the contract between the parties was formed when Mr Smith emailed at 15.38 on 10 November, completing the act of acceptance that he had commenced at 15.37, but which had omitted the promised order confirmation. VAS thereby accepted MSL’s standard terms and conditions, which were the only party’s terms which had been referred to up to then, in the PO, which Mr Smith attached to both of his emails, thereby indicating the terms which VAS was intending to accept. Although the wording of the 25 items of the quotation is not identical as between the quotation (which is cited in VAS’s Sales Order) and the PO, the various differences – none of which is said to be material to the proceedings – did not prevent the parties reaching agreement. I would interpret VAS’s Sales Order as accepting an offer that it provide the 25 items listed in its quotation, as they are described in the PO, which was sent alongside the Sales Order (but noting that the PO itself incorporates by reference certain of the contents of the quotation). Nor does the difference in the description of the trigger for payment of the final 10% of the purchase price prevent the parties from being *ad idem*. “Completion” in VAS’s documentation should be interpreted as “completion of testing”, as in the PO. No other interpretation of “completion” was suggested by VAS. It was not disputed by VAS that an operative reference to MSL’s standard terms being available on request was sufficient to incorporate them, without it being necessary for them to be repeated in the contract or actually asked for by and provided to VAS (see *Circle Freight International Ltd v Medeast Gulf Exports Limited* [1988] 2 Lloyd’s Rep 427). Exceptions are made to that general rule for onerous or unusual terms, but it was not suggested that any of MSL’s standard terms fell into that category.
14. It follows that this is not a “battle of the forms” case where both parties rely upon their own terms and conditions and, usually, the “last shot” – the latest reference to standard terms before contract performance commences – prevails (see, for example, *B.R.S. v Arthur V. Crutchley Ltd* [1968] 1 All E.R. 811). VAS’s last “shot”, its invoice, was fired after the contract had been completed, and in the direction of a different person at MSL, when negotiations had hitherto been with Mr Woolger. The invoice was not necessary to complete VAS’s acceptance and I would not read it as doing so. In any event, the invoice refers only to VAS’s payment terms (30 days from invoice, with property in any goods not passing until full payment is received by VAS), and I would not interpret it as a broader attempt to impose VAS’s terms and conditions on the transaction.
15. It is common ground that the contract between the parties, when it was entered into, required VAS to refurbish, commission and test the Abar so that it could

operate “as new”, as a “6 bar” furnace. I understand that even as a 6 bar furnace, the likely maximum operating pressure of the Abar would be 5 bar (Experts’ Revised Joint Statement, §2.1.1). I should explain that Dr Camplin agreed during his oral evidence that commissioning was the process whereby VAS demonstrated to MSL that the Abar could operate to the contractual standard and do so safely. In the event, James Long of VAS commissioned the Abar on the basis that it would be operating at 0.8 bar (less than 1 bar, and so less than atmospheric pressure), although he tested it at pressures of up to 2 bar. This had various consequences, including that the filter which blew off in the overpressure event had been attached only by a jubilee clip rather than being screwed in to the metal outer shell of the Abar. This method of fixing ought to have been sufficiently robust for a furnace which was operated at negative pressure but was insufficient for a furnace operating at significant positive pressure, hence the filter blowing off after the Abar reached 3 bar pressure.

16. MSL was responsible for providing services to the Abar – that is, electricity, water and gas – in the facility in which it was installed. During the installation and commissioning work, VAS raised with MSL a potential problem that the supply of nitrogen to the Abar, which was through a 15mm pipe, was insufficient to enable the Abar to operate at 5 bar pressure. In VAS’s opinion, a wider pipe, or a buffer tank to store nitrogen close to the furnace, would be necessary. VAS claims that in light of the limitations of the nitrogen supply to the Abar, David Woolger of MSL instructed VAS, in the person of Mike Long, its Managing Director, to commission the Abar to operate at 0.8 bar pressure, because that was how MSL intended to use it, but on the basis that VAS would return in the future to recommission it to operate at 5 bar pressure if MSL did the work necessary to enhance the nitrogen supply. MSL denies that any such instruction was given and denies that the contract was varied so as to change VAS’s commissioning obligations.

17. VAS does not allege that the instruction allegedly given by MSL was written down and cannot point to any document which could be said to constitute a written variation of the contract. In those circumstances, MSL also relies upon §16.8 of its Terms and Conditions of Purchase, a standard “no oral modification” clause which states:

“Variation. Except as set out in these Conditions, no variation of the Contract, including the introduction of any additional terms and conditions, shall be effective unless it is agreed in writing and signed by the parties or their authorised representatives.”

18. Mike Long of VAS argued during his oral evidence that the instruction which he alleges he was given by David Woolger did not amount to a modification of the contract because VAS remained committed to commissioning the Abar to operate at 5 bar pressure once the nitrogen supply issue had been resolved. Counsel for VAS, Mr Shirazi, did not pursue that argument in his closing submissions and I reject it: it would clearly be a change, and a significant one, for VAS to be able to collect full payment for the refurbishment project whilst having done commissioning and testing appropriate to a negative pressure furnace and not as appropriate to the Abar “as new”. (Whilst it does not

matter for present purposes, I understand the former to be, at least potentially, a less onerous task than commissioning and testing a furnace to operate at a much higher, 5 bar pressure).

19. Mr Shirazi did argue that §16.8 only applied to agreed variations of the contract and did not prevent MSL from issuing valid oral instructions, even if these were relied upon by VAS as altering its obligations under the contract. I agree with the submission of Ms Atkins, Counsel for MSL, that that interpretation of §16.8 would substantially undermine its utility and cannot have been what was intended by its draftsman. The upshot is that in the absence of a written variation of the contract, VAS was obliged by the terms of the contract to commission and test the Abar to operate at 5 bar pressure.
20. Mr Shirazi then argued that MSL was estopped from relying upon §16.8, and so from taking the point that there had been no written variation, on account of having given the instruction alleged by VAS. He pointed to authority, including *Kabab-Ji v Kout* [2020] EWCA Civ 6, [2020] 1 Lloyd's Rep 269, §§74-75, in which it was accepted that a party may be precluded by its conduct from relying upon a no oral modification clause when the other party has reasonably relied upon that conduct.
21. There are a number of problems with VAS's invocation of the doctrine of estoppel in this context. First and foremost, promissory estoppel must, in any case, be founded upon a clear and unqualified representation (see *Chitty on Contracts*, §7-006). In the case of a no oral modification clause, a party seeking to rely upon the clause must not merely have made an informal promise but must have represented that the alleged oral contractual variation was valid notwithstanding its informality (*MWB Business Exchange Centres Ltd v Rock Advertising Ltd* [2018] UKSC 24, [2019] AC 119, §16). In my judgment, VAS cannot establish that a clear and unequivocal representation was made by MSL that VAS's contractual obligations were to be varied so that the Abar would be commissioned and tested to operate as a negative pressure furnace. In particular:
 - i) The evidence of VAS's witnesses, including Mike Long, is that the relevant conversation took place between himself and David Woolger on James Long's mobile telephone. James Long had been visiting MSL's premises, had been on the phone to Mike Long, who was at VAS's premises, and then passed his phone to David Woolger who had a conversation with Mike Long, the different sides of which were witnessed by Paul Buttery and Mike Oldham of VAS at Mike Long's end, and James Long at David Woolger's end. This conversation is pleaded (Amended Defence, §14) as having taken place in "March 2019". Mike Long's first witness statement (§22) placed the conversation on 3 January 2019, but this was corrected shortly before trial to "in or around early 2019". James Long also placed the conversation as being on 3 January 2019 (second witness statement, §48) but in late corrections to his witness statement said that he in fact could not remember when in early 2019 the relevant conversation had taken place. Ultimately, and despite examining relevant mobile phone records, VAS has not been able to suggest a date for when the

conversation took place, and the alleged representation was made by David Woolger.

- ii) 3 January 2019 was a significant date in that a site meeting took place on that day at MSL's premises, attended by persons including David Woolger of MSL and Mike Long of VAS, and there was a full discussion of the progress of work in relation to the Abar and the CVE furnace, on which VAS was also working. The issue of nitrogen supply to the Abar was discussed and the minutes prepared by MSL, and commented upon by VAS (in capitals) state:

“• Nitrogen intake pipework too small in order to operate at 5 bar (rated at 6 bar), MSL will need to get their contractor to expand the intake valve. This may cause a drain on MSL's nitrogen air supply and so an additional “buffer” tank may be required - AGREED

• Furnace to be signed off against the original Abar specs provided with the exception of the temperature (acceptable at 1300°C rather than 1370°C) – AGREED BUT ONLY [TEMPERATURE UNIFORMITY SURVEY] TO 1250C”

An action of “*alter nitrogen supply to suit Abar 5 bar requirement & buffer tank check*” was assigned to MSL. The agreement that the Abar should be signed off against its original specifications, save for temperature, and so including the specification that it operate at 5 bar, notwithstanding the nitrogen supply issue, runs directly contrary to the allegation that MSL responded to the nitrogen supply issue by informing VAS that it need only commission the Abar to operate at 0.8 bar.

- iii) MSL did in fact install an additional tank to hold nitrogen gas, and so to assist in maintaining nitrogen gas pressure, in or around June 2019. This was an accumulator tank, smaller than the buffer tank which VAS considered was desirable but which, according to James Long, enabled the Abar to reach higher pressures, at least up to 2 bar. Notwithstanding that improvement in the nitrogen supply, on VAS's case no revision to MSL's instruction to commission to 0.8 bar pressure was made by MSL.
- iv) MSL proceeded to operate the Abar at pressures of up to 2 bar, in order to continue to provide services to the customers of the company which had previously owned the Abar, whose assets MSL had purchased. I accept David Woolger's evidence that it would not have done so in the knowledge that it had instructed VAS to commission and test the Abar to operate at 0.8 bar.
- v) Against all of that, VAS can point to no documentary evidence of the representation that it alleges, and still less of MSL conducting itself on the basis that such a representation was sufficient to vary the contract. Mr Shirazi submitted that the strongest point in favour of the representation having been made is that it was not possible to operate

the Abar at 5 bar pressure without changes to the nitrogen supply, which were not carried out by MSL. That does appear to be the import of the agreed first bullet point from the minutes of the 3 January 2019 meeting set out in §21(ii) above. However:

- a) Andy Leggett of MSL, whom I found to be a helpful and convincing witness, has 26 years' experience of working with vacuum furnaces and had almost two years' experience of working with the Abar after it entered service. He gave evidence that the Abar was capable of reaching 5 bar pressure with a 15mm intake pipe, but that it would take longer to "backfill" the necessary amount of nitrogen than if the intake pipe were widened. VAS's witnesses refuted this but I accept Mr Barraclough's evidence that it is not possible to contradict Mr Leggett's view without detailed calculations and an engineering assessment based on those calculations, which neither the experts nor VAS's factual witnesses had done. Further, Mike Long's evidence on this point – that at the slow rate of ingress into the furnace permitted by the 15mm pipe, nitrogen gas would turn to liquid before 5 bar pressure was reached – was contradicted by Dr Camplin, VAS's mechanical engineering expert. I also note that during the overpressure event, according to those present, the Abar reached 3 bar pressure, notwithstanding the 15mm nitrogen pipe. I therefore find that it was possible for the Abar to reach 5 bar pressure with its existing nitrogen supply pipework, at least for the purposes of commissioning and testing, whether or not it would have been desirable, or possible, to operate the Abar routinely at that pressure without modifying the pipework.
- b) I accept that MSL, most probably through Andy Leggett, did inform James Long of VAS that MSL did not intend to use the Abar at 5 bar pressure but would use it at lower pressures, including at negative pressure. However, that is not inconsistent with MSL wanting the Abar to be refurbished, commissioned and tested so that it was capable of operating at pressures up to 5 bar. I can only surmise that James Long misunderstood an interaction with Andy Leggett as signifying that MSL now wanted a negative pressure furnace (at least in the first instance).
- c) Even if it were, as VAS alleges, impossible for the Abar to reach 5 bar pressure with the existing nitrogen pipework, that would not establish that MSL had instructed VAS to commission and test the Abar to operate at negative pressure, which is the representation posited by VAS. That seems particularly unlikely in circumstances where, as I accept, MSL intended to use the Abar to some extent at least to service customers who required work done at 2 bar pressure, and the

Abar was definitely capable of reaching 2 bar pressure after installation of the accumulator tank in June 2019.

22. In summary, therefore, I conclude that the contractual terms agreed by the parties were those set out in MSL's PO dated 9 November 2017, with the addition of MSL's standard terms and conditions of business. I reject VAS's contention that the contract was subsequently varied as to the specification of the pressure at which the Abar was to be commissioned and tested. I also accept, as is common ground between the parties, that the contract also included the terms implied by the Supply of Goods and Services Act 1982 whereby VAS was to perform the contracted services with reasonable care and skill (s. 13), and that goods supplied were to be of satisfactory quality (s. 4(2)) and fit for their purpose (s. 4(5)).

The allegations of breach of contract

23. There is a list of alleged defects in §20 of the Particulars of Claim ("PoC") which is taken directly from the defects identified in the VFS report (see §5 above). Reading §20 with §24 PoC, these defects are alleged to represent breaches of contract including because of a failure to perform the contracted works with reasonable care and skill or a failure to carry out the contracted works in a workmanlike manner.
24. §20.1 PoC alleges that: "*The vacuum furnace was said by VAS to have been commissioned as a low pressure, sub-atmospheric, quench furnace yet is capable of back filling with gas past atmosphere*". For reasons I have already considered, VAS breached the contract by commissioning the Abar as a negative pressure furnace. I also accept that its conduct left MSL in the worst of all worlds, in the manner identified by VFS. MSL got a furnace which it understood was commissioned and tested to 5 bar pressure, but which was in fact only commissioned to 0.8 bar pressure and tested to 2 bar pressure. Further, as demonstrated by the overpressure incident, despite having been commissioned as a negative pressure furnace the Abar was able to reach pressures substantially higher than that (3 bar on that day) yet was not fully equipped to cope with such pressures. Hence the ejection of the air admit filter, which – James Long accepted in his evidence (second witness statement, §54) - was appropriate to a negative pressure furnace but not one operating at positive pressures. The breach pleaded in §20.1 PoC is established.
25. §20.8 PoC alleges that: "*The safety pressure valve is set to 6.6 bar and should have been downgraded to just above atmosphere if the system had been programmed as a low pressure, sub-atmospheric, vacuum furnace*". The safety pressure valve, which is the final fail-safe to prevent potentially dangerous overpressure, was set by VAS at 6.51 bar. The mechanical experts, Mr Barraclough and Dr Camplin, agreed that this was too far above the 5 bar maximum operating pressure of the Abar, and unacceptably reduced the engineering safety margin between the maximum operating pressure and the manufacturer's test pressure. They agreed that the valve should be reset to 5.4 bar (Revised Joint Statement, §§2.1.5-2.1.6). That is not quite the breach pleaded in §20.8 but I am prepared to read that paragraph as alleging that the

safety pressure valve was incorrectly set at too high a level, albeit that the correct level is mis-stated. I also agree with Mr Barraclough (§3.1.9 of the Revised Joint Statement) that, as pleaded in §20.8, the setting of the safety pressure valve was also too high for the valve to be effective in a negative pressure furnace which was not intended to exceed 1 bar pressure. There would have to be an enormous overpressure in such a furnace before a safety valve set at 6.6 bar would be triggered, meaning that the safety pressure valve would not serve any useful purpose as a final fail-safe for smaller but still potentially dangerous overpressure events. The breach pleaded in §20.8 PoC is established.

26. §20.2 PoC alleges that: “*The water flow IFM switches on the power-in lead circuits are faulty and do not alarm for a flow fault when the water is turned [off]*”. The mechanical experts agreed that the water flow switches were faulty, giving incorrect readings when the water flow was turned off and, in one instance, failing to raise a safety critical alarm to alert the operator to loss of water flow (Revised Joint Statement, §§2.1.14-2.1.15). However, the experts were unable to determine whether these problems were caused by defective software or hardware (which would have been VAS’s responsibility) or contamination of the water supply to the Abar due to insufficient maintenance by MSL. MSL argues that even contamination of the water supply would have been down to VAS because Mr Leggett gave evidence of VAS’s failure to clean the Abar’s water system properly before it was installed. That failure is said to have resulted in a report of 11 September 2019 by a company called Hydratech which identified sediment and biological contamination in the water, and then in MSL installing a new water system to ensure a better water supply in the future. There is, however, no firm basis on which I could accept that any such problems caused by VAS’s work before the Abar went into service continued almost two years later when VFS inspected the Abar. It is more likely that if (which is unclear) the water flow switch problems identified in 2021 by VFS and confirmed subsequently by the experts were caused by contamination of the water supply that this was down to ineffective maintenance by MSL between 2019-2021. The breach pleaded in §20.2 PoC is not established.

27. §20.3 PoC alleges that: “*The water pressure switch mounted on the bottom [of] the water inlet manifold is likely blocked due to incorrect positioning and does not function when the pressure in the vacuum furnace drops. A service valve should be fitted*”. The breach pleaded in §20.3 PoC is established on the basis of the evidence of Dr Camplin, VAS’s mechanical expert. I found Mr Camplin to be a measured and balanced witness, who readily accepted points which he considered to be correct, but which were contrary to the interests of his clients, and whose explanations were of considerable assistance to my understanding of the technical aspects of the claim. He has compiled a minimum list of modifications to the Abar which should be carried out in order to ensure that the Abar is operational to its original specification (which was a contractual obligation of VAS) and can operate safely, without repeat of the overpressure incident: see §2.2.23 of the Revised Joint Statement. One of the essential modifications is that “*the water flow manifold should be remounted in the vertical orientation as it is on the Solar furnace*” (another

furnace operated by MSL). I accept Dr Camplin's list as a fair and accurate assessment of the mechanical work which needs to be done to render the Abar safe for use (noting that Dr Camplin's colleague Mr Heath was engaged to comment on electrical, including PLC, issues).

28. §20.4 PoC alleges that: "*The vacuum furnace does not have a pneumatic pressure switch fitted*". The original Abar specification included a pneumatic pressure switch on the nitrogen supply to the furnace, as did the functional design specification drawings for the PLC. The purpose of the pneumatic pressure switch was to detect and sound the alarm when nitrogen flow dropped below minimum levels. I cannot see that VAS was under a contractual obligation to replicate in full the original design of the Abar. According to the experts, the original pneumatic pressure switch was installed for a gas supply system which supplied nitrogen independently for the backfilling of the furnace on the one hand and the pneumatic manifold (a device containing several pneumatic valves) on the other. Whereas the nitrogen supply to the Abar, which was MSL's responsibility, was not independent as between these two destinations, and the experts agree that a pneumatic pressure switch would not have been effective in such a configuration. Dr Camplin's list of essential works recommends that the nitrogen supplies be separated, which would be a matter for MSL. Based again on the common view of the experts, it may be that the task of a pneumatic pressure switch is performed elsewhere within VAS's refurbishment design, but the documentation supplied by VAS to MSL and disclosed in the proceedings is inadequate to demonstrate what if any risk assessment was done of the performance of the Abar's pneumatic system. Unsatisfactory as this is, the breach pleaded in §20.4 PoC, which is simply that the Abar should have had a pneumatic pressure switch fitted, is not established.
29. §20.5 PoC alleges that: "*The heat exchanger in the vacuum furnace is unsafe and currently relies on the pressure switch for water safety, which allows water loss to build up internal pressure. This should be protected by a mechanical flow temperature switch*". The mechanical experts agree (Revised Joint Statement, §2.1.41) that relying on a pressure switch in the Abar's heat exchanger could lead to overheating and overpressure within the heat exchanger and that a flow switch would protect against both of these conditions. Dr Camplin includes replacing the pressure switch with a flow switch within his list of essential works. The breach pleaded in §20.5 PoC is established.
30. §20.6 PoC alleges that: "*There is no flow switch installed on the heating transformer cooling circuit, which is standard for safety purposes*". This allegation is not supported by the expert evidence. The mechanical experts did not accept that the presence of a flow switch on the heating transfer cooling circuit was standard for safety purposes (Revised Joint Statement, §2.1.45). They agreed that additional safety equipment would have been fitted to the transformer electrical supply (§2.1.46) and Dr Camplin's view, which I accept, is that a flow switch need only have been fitted if such other measures failed to address an unacceptable safety risk, of which there is no evidence (§2.19 of his joint report with Mr Heath dated 15 February 2024).

Mr Barraclough complained on behalf of the Claimant that VAS had not produced a design risk assessment or safety assessment which would reveal the safety system which was in place for the heating transformer. I would accept that that is unsatisfactory, but I agree with Dr Camplin, and with VAS, that this does not establish that there was no safety assessment (VAS says there was, albeit poorly documented) or that the system put in place by VAS was insufficient without a flow switch. The breach pleaded in §20.6 PoC is not established.

31. §20.9 PoC alleges that: *“The gas backfill valve should be a spring assisted return on closing in actuator so as to keep the valve closed should pneumatic pressure failure occur”*. Dr Camplin agrees in his list of essential works that the co-dependent nitrogen gas supply system (see §28 above) which was in place when the Abar was commissioned and tested should incorporate a spring return valve on the nitrogen backfill supply (as opposed to the dual action actuated butterfly valve which was installed). Although this would not be necessary if nitrogen supplies were independent as between the supply for backfill and the supply to the pneumatic manifold. Dr Camplin and Mr Barraclough agree that a spring return actuator could have been closed even under very low gas pressure to the manifold. This would be a potentially valuable safety addition in the event that there is a loss of pressure to the manifold caused by the co-dependence of its gas supply with the backfill supply. It could have prevented the overpressure event. The breach pleaded in §20.9 PoC is established.
32. §20.10 PoC alleges that: *“The vacuum furnace does not have a high-pressure safety switch (BSP3) to cut gas backfill out and the electrical schematic is wired to KF10”*. This plea is not supported by the expert evidence. The experts agree that the Abar had a chamber pressure switch which would activate an input on the PLC in the event of a threshold being exceeded but which did not operate to cut the nitrogen gas backfill. Mr Barraclough and Dr Camplin are agreed that *“we have not seen evidence of design risk assessments by VAS that justify the inclusion or exclusion of a high-pressure safety switch as a safety function to cut the gas backfill, rather than rely on the PRV, which would be considered to be a “last line of defence””* (Revised Joint Statement, §2.1.60). I understand this to mean that they are unable to say one way or the other whether it was necessary for there to be a pressure safety switch in the furnace chamber which cut the nitrogen gas backfill. In closing, MSL made a different point, that the chamber pressure switch had not sounded an alarm during the overpressure incident and therefore was defective. It is unclear whether no alarm was sounded because the switch failed, or whether it was not sounded or was not heard because there was already a different alarm sounding (as the cross-examination of Mr Heath revealed). In any event, however, this is not the pleaded breach, which argued for a different switch than the one which had been installed. The breach pleaded in §20.10 PoC is not established.
33. §20.12 PoC alleges that: *“The fitting of the air admit filter is not suitable for the high-pressure release of gas through the air admit valve”*. This breach, which was evident from the overpressure event, is admitted (see above, §24).

34. §20.14 PoC alleges that: “*Electrical schematic drawings were not prepared or completed by VAS*”. VAS’s quotation had offered, under Item 24, “*All new manuals and drawings*” and, under Item 25, that “*an all new full set of wiring schematics will be created and supplied*”. The latter wording was not expressly included in MSL’s PO, but the items listed in the PO were, in general, to be understood “*in accordance with [the] quotation*”. In his oral evidence, James Long accepted that wiring drawings sent to MSL at the conclusion of the project had not been updated to show the “as built” wiring (Day 2/204/3-9), which must have been what was intended by the contract terms. The breach pleaded in §20.14 PoC is established.
35. §20.15 PoC alleges that: “*The vacuum furnace software programme suffers from intermittent issues particularly related to setting values returning to default after the [power] cycle*”. MSL complained about the PLC losing data during the commissioning process, and prior to handover in October 2019. There is a dispute between the parties as to whether that issue persisted at and following handover – James Long of VAS contends that the PLC was saving data as expected and there is no documentary evidence to show that it wasn’t. There is a large file of “UUh data” which tracks the performance of the Abar during its use by MSL over 200 cycles, between 22 August and 17 December 2019, 6 January and 21 December 2020 and 4 January to 14 June 2021. Mr Heath notes, and I accept, that there is nothing in the documents to indicate that these cycles did not complete successfully. Mr Barraclough and Mr Heath agree that without extensive research and analysis of the data files, it is not possible to say if they support the alleged intermittent PLC issues (Revised Joint Statement, §2.1.75). During the trial, MSL pivoted to arguing that the overpressure incident was evidence of the PLC not functioning as intended. The PLC was one possible contributory cause of the overpressure incident, but even if it was to blame on that day, this is not the “*intermittent issues*” alleged in §20.15 (but a single event, not said to be related to reverting to default settings after a cycle). The breach pleaded in §20.15 PoC is not established.
36. §20.16 PoC alleges that: “*There is no evidence to demonstrate that the vacuum furnace has been tested and commissioned prior to handover*”. This breach is not established. There is in fact evidence of the Abar being commissioned and tested by James Long prior to handover in the form of his handwritten notes, supported by his witness evidence. James Long himself accepted that his notes are in certain respects incomplete and misleading. They seem to me to be surprisingly informal given the safety-critical nature of the activities being carried out, and the potential need to evidence in the future what work had been done on the Abar after installation. The experts agree. Mr Barraclough and Dr Camplin state (Revised Joint Statement, §2.2.19): “*We would therefore expect the commissioning records to detail that suitable levels of risk assessment, planning and coordination with the client were carried out. The current handwritten records fall short of that level of detail*”. But the notes do constitute contemporaneous evidence of commissioning and testing of the Abar prior to handover.
37. §24 PoC sets out the various different ways in which the defects pleaded in §20 are alleged to constitute breaches of contract. The only sub-paragraph of

§24 which was relied upon at trial as adding something to the defects in §20 was §24.5 which alleged that VAS had “[Failed] to carry out adequate testing during the commissioning process, particularly in relation to potential for the furnace to exceed pressure when the specific furnace cycle should have prevented this”. There is agreement between Mr Barraclough and Dr Camplin that the cause of the overpressure event was a failure of nitrogen supply to the pneumatic manifold, which was itself caused by the co-dependence of the nitrogen supplies to the backfill and valve manifold, and which resulted in the failure to close of the pneumatic backfill valve when the Abar reached the programmed pressure. They agree that it was foreseeable that an overpressure event could occur if the backfill valve was open and there was a failure of gas supply to the pneumatic manifold. They also agree that the particular failing which led to the overpressure event would have been revealed by a detailed risk assessment of the system for operating the Abar (Revised Joint Statement, §2.2.21). Mike Long accepted in his oral evidence that VAS should have risk-assessed the possibility that a reduction in gas supply to the manifold would mean that the backfill valve failed to close. A failure to risk-assess is not the same as a failure to test, which is the pleaded allegation, but the former can be expected to lead to the latter, as without a risk assessment, an engineer will lack essential guidance as to which tests need to be carried out and why. Further, Mr Barraclough and Mr Heath agree that there is no evidence of a risk assessment or a commissioning test relating to the ability of the PLC to prevent an overpressure event (Revised Joint Statement, §2.2.21). James Long was cross-examined at length on this issue and was unable to provide a convincing explanation or any satisfactory documentary support for his contention that he had carried out relevant testing in relation to the issues which had led to the overpressure event. I conclude that the breach pleaded in §24.5 PoC is established, taking into account (a) the fact that the overpressure event occurred, (b) VAS’s failure to compile a risk assessment in relation to the potential for the Abar to exceed pressure, in particular as occurred during the overpressure event, (c) James Long’s unsatisfactory evidence on this point and (d) the absence of evidence of appropriate testing of the PLC.

38. In summary, I find that MSL has established breaches of contract as pleaded in PoC §§20.1, 20.3, 20.5, 20.8, 20.9, 20.12, 20.14 and 24.5.
39. There was considerable debate during the trial about other possible breaches of contract, beyond those expressly pleaded, in particular concerning VAS’s failure to compile or produce in evidence detailed design risk assessments. No application was made to amend the PoC, and I have not treated failure to risk assess as a separate head of claim. I have, however, taken into account the absence of documented risk assessments insofar as relevant to the pleaded breaches. It is also relevant to the issues of causation and quantification of loss, to which I now turn.

Causation, loss and damage

40. At first blush, the issues of causation and quantification of loss are relatively straightforward. Thankfully, there were no injuries or other lasting damage as a result of the overpressure event, and its principal significance was to prompt investigations into whether the Abar had been refurbished in accordance with

the contract and was safe to use. A number of defects have been identified, and the usual measure of damages in a case of defective works is the cost of reinstatement of the property in question to the state in which it should have been left by the defendant if the work had been done without breach of contract. A different approach may be adopted, for example, where the cost of reinstatement is considerably more than the diminution in value of the property due to being in a defective state, but MSL does not argue that the cost of reinstatement is an inappropriate measure in principle in this case.

41. As I have noted in §5 above, VFS quoted £12,850, to include hotels, travel and meals, for the reinstatement of the Abar to a state where it was safe to operate. The VFS report stated, materially:

“Highlighted Issues

In our opinion, at the moment, this furnace is not safe to use due to many of the safety features either installed badly, not installed or not working. We have listed below essential repairs for your attention.

1. Heat exchanger water safety switch, replace with flow switch. Supply and fit a new IFM type switch in to the existing ½” socket welded in to the pipe work on the water supply side. This would also require a Software and PLC modification as shows alarm at the moment on the HMI screen, but does not stop the cooling fan motor.

2. Move the water pressure switch, clean and fit a service valve. Use the existing switch if not damaged and have ½” socket welded in to existing pipe work, will not need any PLC mod as this works.

3. Fit a flow switch into the water circuit of the heating transformer. IFM type switch can be fitted on the return manifold, on a tee, PLC and software mod required.

4. Fix the 1 & 3 PLI water circuit faults and set up correctly to alarm on mimic. This might be just cables mixed up, but may also need a PLC and software Mod as one of them shows full flow when turned off.

5. Change air admit filter for something fit for application, if over pressure quenching being used in production. Fit a metallic industrial type silencer to withstand gas released from the furnace at any workable pressures above atmosphere.

6. Find high pressure gas safety switch and test or fit if not on furnace at present. If fitted then needs to be tested, if not fit IFM type switch with PLC and Software mod.

7. Fit spring return type actuator to gas back fill valve, to close or keep closed on pneumatic pressure loss. This can be supplied, fitted and tested as standard stock item.

8. Supply and fit a pneumatic pressure switch on to the supply manifold, wire in to PLC and Software as a mod.

9. Change existing vessel gas safety valve set at 6.6 Bar, if only ever to be used at sub atmospheric gas fan quenching. (Not included in price below). Can quote and supply if requested.”

Although we have the software for the PLC, we would need to have total access to all passwords etc, to get in to the control system/PC. The existing panel electrically may need minor additions such as relays, contactors.

Please take in to account there may be other problems with the auto cycle function, when we start testing in earnest.

An estimate for the costs of the above work to get the furnace in to a position to safely operate, with the existing control system.

Price: £12,850 Includes Hotels, travel and meals.

The above price may be reduced, depending on the magnitude of the software issues, as at the moment we cannot view the present system.” [bold in original]

42. The figure of £12,850 falls to be reduced because only four out of eight items for which VFS was quoting correspond to breaches of contract which I have found to be established (issues numbered 1, 2, 5 and 7: see PoC §§20.5, 20.3, 20.12, 20.9). The others (numbered 3, 4, 6 and 8: see PoC §§20.6, 20.2, 20.10, 20.4) correspond to alleged breaches which I have found not to be established. I have little basis for estimating how great a reduction is called for, since the cost of VFS’s “issues” was not itemised, but on a rough and ready basis I will estimate a reduction of 50%, to reflect a reduction of 50% of the issues for resolution, to £6425. The cost of fixing issue 9 is not included in the quotation but does not arise because the Abar was intended to be used at positive pressure. The relevant cost would be for re-setting the safety pressure valve (see PoC §20.8), which I would assume to be minimal. On the other hand, if it were truly to reflect the cost of reinstatement, VFS’s quotation would fall to be increased because it does not include the cost of providing “as built” electrical schematic drawings (see PoC §20.14). I have very limited evidence of the likely cost of updating VAS’s drawings to an “as built” status, as in VAS’s quotation this cost was subsumed within the much larger cost of supplying the PLC. Doing the best I can, and noting the daily rate of £752 for the services of a VAS engineer (see §56 below), I add £1575 for this element.
43. I would also add to the likely cost of reinstatement an additional cost for commissioning and testing of the Abar to 5 bar pressure. This was not done by James Long and nor did Mr Long document any risk assessment of the operation of the Abar as the experts agreed he should have done. I accept the evidence of MSL that any other contractor would need further assurance, beyond repairing the essential defects, that the Abar was functional and safe to operate as a 5 bar, positive pressure furnace before signing-off its work. Such assurance may well involve risk assessment and testing consequent upon that assessment. VAS charged £4860 for commissioning and testing. VFS’s quotation included limited testing and may be taken to assume that commissioning of the Abar had been carried out satisfactorily. I am confident

that VFS would have included a significant amount for re-commissioning and testing of the Abar had it been aware of the shortcomings of VAS's commissioning work. I include an additional amount to cover the further commissioning and testing of £7000 as part and parcel of what it would have cost MSL to engage a contractor to repair the defects which I have found to be present in the Abar following VAS's work on it. This is more than VAS charged, but, as well as the daily rate for the services of a VAS engineer, I take into account that much more work was potentially required than VAS has established that it performed, in particular in providing comprehensible documentation, and that commissioning and testing may be more time-consuming for a contractor which has not refurbished the Abar and so was not familiar with it to the same extent as VAS was. Contrary to a criticism made by VAS, awarding damages in respect of this work is not to permit MSL to maintain an unpleaded claim of breach of contract: this is work which, in my judgment, would have been required to be carried out when repairing the pleaded defects which I have found to be established, and which it was proved at trial that VAS did not itself carry out and/or document satisfactorily or at all.

44. VFS's quotation included some software/PLC modification work but it also entered a caveat that a more detailed investigation of the PLC might reveal further essential work, and also that the eventual amount might be less. In the circumstances, I do not add any amount to account for additional work on the PLC. Using the VFS report as my starting point, and doing the best I can, I assess the cost of reinstatement as £15,000.
45. VAS has produced its own estimate for carrying out the essential repairs identified in the VFS report which, for VFS issues 1, 2, 5 and 7, is £2686.89. I regard this as less reliable than VFS's estimate because it is not contemporaneous but was formulated at a late stage of the litigation, on 13 March 2024, at a time when VAS's interests lay in minimising these costs. I was given no explanation as to why VAS did not estimate the costs of repairing the Abar at a much earlier stage.
46. MSL's primary case is that, consequential losses aside, the loss it has suffered due to VAS's defective performance of the contract should be assessed as being the full cost of the refurbishment of the Abar, including the cost of the new PLC, being £199,015. MSL put forward two arguments to justify this claim for the entire cost of the refurbishment project. The first was that "*MSL requires proof, via adequate commissioning that the furnace is safe to operate. It can only obtain such proof if the refurbishment and commissioning process is carried out fresh, i.e. so that all necessary documentation is produced*" (Closing Submissions, §54a). I have already accepted that, on reinstatement of the Abar, there will need to be proof that it has been properly commissioned and tested, which is likely to involve risk assessment, and I have allowed for that in the cost of reinstatement, taking into account that commissioning and testing was a small proportion of the total cost of refurbishment.
47. The total cost of £199,015 included new parts for the Abar, refurbishment of parts and repainting which MSL has made no attempt to establish were

defective or otherwise not in accordance with the contract. For example, item 1 on VAS's quote was an "all new hot zone" priced at £26,675 and item 4 an "all new hot zone frame" priced at £8525. MSL has not suggested that there was anything wrong with what VAS supplied under these heads. In total, items in this category total £115,885, excluding the new PLC, which was priced at £74,450. Even if a contractor were engaged to carry out a full refurbishment of the Abar, there is no reason to think that any of these items would have been replaced or fully refurbished once more, or done over, in the case of repainting, or that the proof that MSL argues that it requires can only be obtained if these items were all replaced or fully refurbished afresh or done over. MSL has not obtained any quotation from a contractor to support the proposition that a "full" refurbishment is necessary. Clearly, that was not VFS's view. MSL did submit that the PLC supplied by VAS was faulty and its claim for the full cost of the project includes the full replacement of the PLC. However, it has not come close to establishing that the issues with the PLC were so serious that it required replacement, at the same cost as VAS originally charged for it. I have rejected the plea in PoC §20.15 regarding the PLC having intermittent faults, and VFS's quote includes the cost of necessary modifications to the PLC (both its hardware/wiring and software). Whilst it is possible that further investigation of the PLC's functioning may reveal more serious problems, MSL cannot base its case on causation of loss on the fear that something much worse may turn up.

48. MSL's second argument (Closing Submissions, §54b) is that it "*has tried to find companies that are able to carry out limited or wholesale repairs to the furnace, without any success*". I reject that submission, and Mr Woolger's evidence to that effect, simply on the basis of the VFS report. VFS's quoted "Price" can only be read as an offer to do the essential repairs which it had identified. That is why they entered a caveat that they might find more problems "*once we start testing in earnest*" and included the cost of hotels, travel and meals for its engineers. MSL did not take up VFS on its offer to perform the repairs. It did not respond to VFS at all but sent the VFS report to VAS. Mr Woolger did not contact VFS about its quote again until "*very recently*". In his fourth witness statement, he explains that VFS's quote "*was not viewed as an option without a full replacement of the PLC as this was integral to the overall safety and control of the system. The need to complete full testing, commissioning and safety checks was also highlighted*". The perceived need for a full replacement of the PLC was the view of MSL alone, not VFS (which didn't say that in its report and was not contacted for further advice). As I have explained, MSL has not established that a full replacement of the PLC was necessary. I have accounted for the costs of full testing, commissioning and safety checks in my estimate of the costs of repairs and I see no reason why VFS could not have been invited to add to its quotation to cover those checks in full.

49. On 30 April 2024, again shortly before the trial, Mr Woolger contacted another potential contractor, Vacuum Furnace Engineering Ltd ("**VFE**") which is the only UK-based contractor other than VAS and VFS to do this type of work. He did not ask VFE to quote for repairs to the Abar but asked them instead to quote for refurbishment to "as new" with a new PLC and

control system. VFE refused to quote for a full refurbishment on the grounds that the Abar could not be CE-marked. This appears from emails exchanged between VFE and Mr Woolger; a phone call which preceded the exchange was not noted or minuted, despite Mr Woolger's intention in contacting VFE being to lay the ground for the trial and may have shed further light on VFE's stance. VAS also invites me to find that it was prepared to carry out the repairs, based on Mr Long's second witness statement of 13 March 2024. I decline to do so: Mr Woolger's evidence, which I accept, was that VAS did not respond to the VFS report in autumn 2021 by offering to do the work itself, but (he said) with an aggressive letter from its lawyers. Nevertheless, MSL has not established the somewhat surprising proposition that there was, and would be, no contractor willing to carry out essential repairs to the Abar. It seems to me that the true position is that MSL has not been concerned to find a contractor to carry out those repairs, but only to strengthen its legal case against VAS. I find that VFS for one would have been willing to carry out repairs to the Abar if it had been asked to do so.

50. I therefore reject the claim that MSL has suffered losses in the full amount of the contracted refurbishment cost of the Abar. In its Closing Submissions (§61), MSL floated a yet further case on quantification of loss, namely that of the diminution in value of the Abar based on its current value on the market as compared with its value if it had been correctly refurbished, commissioned and tested. This basis was not pleaded, and the Court does not have anything like sufficient evidence on which to reach a view on the two relevant valuations. I take this alternative claim no further.
51. Instead of ensuring that the Abar was reinstated promptly, MSL decided to leave it unused and to run other furnaces instead. It claims for the additional costs of running other furnaces (up to 19 October 2022, when a furnace which directly replaced the Abar came online), whilst leaving the Abar furnace unused (up to 16 August 2023), in the amount of £57,608.17. These were described by Ms Atkins in opening submissions as "*costs in mitigation*" and the burden was on MSL to plead and prove that its expenditure in mitigation of its primary loss (defects in, and so loss of use of, the Abar) was reasonably incurred (see, for example, *Zurich Insurance Plc v Umerji* [2014] EWCA Civ 357, §37). In my judgment, MSL has not established that its approach was a necessary or reasonable one and, in particular, has not satisfactorily explained why it did not have the Abar reinstated promptly, at relatively modest cost, which could have been claimed from VAS, rather than incurring what it says were substantially greater costs by using other furnaces instead of the Abar, whilst leaving the Abar unused. Indeed, there were, according to MSL, water system costs associated with not using the Abar, in the amount of £21,295.12, very likely more than it would have cost to get the Abar up and running again. These findings justify the conclusion either that MSL has not proved that the claimed losses in mitigation were reasonably incurred and so were caused by VAS's breach of contract, or that MSL has failed reasonably to mitigate its losses. VAS pleaded (in §27 of its Defence), and argued extensively at the trial, that MSL had not satisfactorily proved that its alleged losses were caused by the alleged breaches of contract and that is the primary basis for my findings against MSL in this regard. VAS did not expressly plead a failure by

MSL to mitigate its loss, although it took that point without objection in both opening and closing submissions and put the substance of its case on mitigation to Mr Woolger in cross-examination. If it were necessary, I would find against MSL's claim for losses in mitigation on that alternative basis.

52. There would undoubtedly have been some delay after the overpressure incident before the Abar could be repaired and the relevant commissioning and testing carried out and the question arises whether MSL should be entitled to claim "*losses in mitigation*" during that period of delay. Again, however, I take the view that MSL has not proved its alleged losses to the requisite standard:

- i) MSL did not seek to establish any alternative case as to having incurred losses in mitigation during a shorter period before the Abar could be repaired (instead arguing, unsuccessfully, that such repairs were not possible). It is conceivable that the necessary repairs could have been completed quickly but I have no firm evidence on which to base a finding as to what the relevant period of delay would have been. VFS provided its quotation on 3 September 2021 but there was no evidence adduced at trial regarding the date of instruction of VFS and why it took VFS until 3 September 2021 to provide its quotation following visits to MSL on 30 July and 4 August 2021. Or as to how long it would have taken to schedule repairs by VFS or another contractor if others had been approached.
- ii) The factual foundation for the allegation that it was necessary to run other furnaces whilst the Abar was out of use is that this was "*to avoid defaulting on pre-existing contracts*" (MSL's Closing Submissions, §62). However, Mr Woolger was challenged on this subject in his oral evidence and he agreed that there had been no disclosure of any pre-existing contracts. His written evidence was very brief indeed on this issue, stating only that other furnaces were run "*to avoid losing contracts*" (first witness statement, §14), which is not necessarily the same thing as defaulting on pre-existing contracts. As there was no evidence of the contracts in question, which MSL says that it stood to lose, or to default on, and so no evidence of the contractual timescales which MSL was working against, I cannot find that MSL has proved a case that it was reasonable to run alternative furnaces during the period in which it was reasonable for the Abar to remain offline if MSL had been seeking to have it repaired promptly, whatever that period would have been.
- iii) The evidence of the alleged additional costs incurred through using alternative furnaces was also sparse, consisting of a single subparagraph of Mr Woolger's first witness statement (§14.2) and some schedules which are said to show the additional electricity costs for each alternative furnace run. There was no disclosure or other "raw" evidence setting out the actual costs of running the other two furnaces and the comparative costs of running the Abar. Mr Woolger said in §14.2 that additional costs were incurred because the other two furnaces are larger than the Abar so were "*run at sub-optimal loading*,

as a result of which our energy usage has been greater than would have been the case with the Abar furnace". I can readily accept that it may cost more in electricity to run a larger furnace but the relevance of sub-optimal loading to this calculation is not self-evident and I did not find the schedules to which Mr Woolger referred to be self-explanatory. They appear to show, for each furnace run, a "cost per run", the "% of load", which I understand to be the percentage of capacity of the furnace being used and then a figure for "Total Cost", which is the former multiplied by the latter. So, as I understand it, a claim is made for 50% of the cost of running the "Large Solar" furnace which was used to 50% of its capacity on each run, and for 60% of the cost of running the smaller "Solar" furnace, which was used to 60% of its capacity. It is not obvious why that is the appropriate calculation. Further, no reduction is made for what would have been the cost of using the Abar instead of the Large Solar or Solar furnaces. The alleged cost of using the Abar may be the other 50% or 40% of the cost per run of the other furnaces, but that would not explain why the cost of using the Abar is assumed to be different depending on which other furnace was used instead. It would have been a simple matter for MSL to provide further evidence from Mr Woolger, and disclosure, to support and explain these claimed additional costs. They appear to have been regarded as self-evident but, in my judgment, more probative evidence was required.

- iv) I also accept the submission of VAS that the staff overtime costs which allegedly resulted from using furnaces other than the Abar have not satisfactorily been explained. Mr Woolger says (§14 of his first witness statement) that "*MSL has compensated for the lost capacity caused by the Abar furnace being offline by running extra shifts and weekend working on other furnaces*" and provides a schedule of employees, dates, hourly overtime rates and total cost for each shift. Again, however, no disclosure was made of documents such as timesheets, diaries or payslips and there are anomalies in the schedule which call for explanation, including different pay rates being used for the same employee on the same day of the week, and different employees earning overtime over different periods in respect of the same furnace run. Nor was there any explanation as to why, as it appears, until November 2021, overtime was only required to be paid to run the Solar furnace and not the Large Solar furnace. These matters may have been capable of ready explanation, and support by disclosed documents, but in my judgment it was not sufficient for MSL merely to present its Schedule and rely upon it in the face of sustained criticism from VAS.
- v) Nor was there sufficient evidence to explain the claimed water system costs (which amounted to the cost of 96 kwh of electricity per day). Mr Woolger deals with this issue very shortly indeed in his evidence, stating that "*water system costs have continued to be incurred to ensure the chamber is usable again at some point*" (§27 of his third witness statement) and again there was no relevant disclosure. I would have expected to see a more detailed explanation as to why it was

necessary to run the water system in the Abar every day, whether this was necessary immediately following the overpressure event and on each day on which the Abar was not used thereafter and whether water system costs would have been incurred for the Abar even if it had been in good repair (for example, on the days when it was not being used), in which case some deduction should have been made from the claimed water system costs.

- vi) I have been prepared to adopt a broad brush approach, involving a certain amount of speculation, in quantifying MSL's losses in respect of reinstating the Abar (see §§42-43 above). However, accepting and quantifying the alleged "losses in mitigation" would require me to go significantly beyond that, to pluck figures out of air and to accept claims which are not self-evident and for which MSL has provided only the most cursory evidence or explanation when further evidence and explanation must have been available to it.
53. MSL claims £19,335 in respect of the costs of collection, delivery and installation of the Abar, but these costs are premised on it being necessary to send away the Abar for a further refurbishment, meaning that there would need to be a further set of transport and installation costs. I reject that premise: the Abar could and should have been repaired *in situ*. Finally, MSL claims £1600 in respect of the cost of obtaining the VFS report. This does seem to me to be a recoverable head of loss: VAS's breaches of contract resulted in defects in the Abar and it was entirely reasonable for MSL to commission an independent investigation to ascertain what needed to be done to rectify those defects.
54. In total, therefore, and before turning to the counterclaims, I would award MSL damages for breach of contract in the amount of £16,600 net of VAT.

The counterclaims

55. There are two counterclaims. One of the counterclaims, for payment of an invoice (numbered 18751) of £2196.78 (£1830.65, plus £366.13 of VAT) in respect of three replacement heating elements for the Abar is conceded in principle, subject to a plea of set-off. The only issue is whether contractual interest is to be calculated as per VAS's terms and conditions or as per MSL's terms and conditions. As with the contract for refurbishment of the Abar, I find that MSL's terms and conditions applied. This was stipulated in MSL's purchase order. VAS then delivered the goods (on 17 February 2021) and only after having done so (on 22 February 2021) sent an invoice which referred to its own payment terms. As with the refurbishment contract, this contract was formed, and indeed performed, before VAS's terms and conditions were mentioned. Contractual interest therefore falls to be calculated at MSL's standard rate of 2% above base rate.
56. The other is for payment of an invoice (numbered 18908) for £902.40 (£752 plus £150.40 of VAT) for work done on 24 March 2021 on the CVE furnace. MSL's terms and conditions again applied, as stated in its purchase order for this work. Again, VAS's invoice, referring to its payment terms, was only

sent (on 26 March 2021) after the contract had been performed. MSL refuted liability for this invoice firstly on grounds that it was for work which should have been performed by VAS without charge under the warranty which applied to the CVE furnace. MSL has provided no evidence or more detailed argument to establish that that is the case but in any event I cannot accept that it would be grounds to set aside or ignore the terms of the contract that MSL entered into,

57. I do, however, agree with MSL that it is entitled to set-off its liability under the two invoices against VAS's liability for breach of the contract to refurbish the Abar. This is provided for by §8.8 of MSL's terms and conditions which states: "*The Company may at any time set off any liability of the Supplier to the Company against any liability of the Company to the Supplier, whether either liability is present or future, liquidated or unliquidated, and whether or not either liability arises under the Contract*". MSL is entitled by this clause to set-off its liability under the separate contracts for work done on the CVE furnace and for the supply of additional parts for the Abar against the larger amount of VAS's liability to it under the contract to refurbish the Abar. MSL was accordingly not liable to pay the invoices, due to VAS already having committed breaches of contract causing damage in excess of the invoices (albeit that that damage was unliquidated and had not yet been quantified). Whilst MSL did not formally invoke its right of set-off in respect of the invoices when VAS pursued payment of them, it did in substance refute any liability to VAS after the overpressure incident having regard to its complaints about the work that VAS had done on the Abar.
58. Therefore, my conclusions on the counterclaims are that MSL is liable to pay VAS £1830.65 in respect of invoice 18751 and £752 in respect of invoice 18908, net of VAT, to be set off against MSL's award of damages. Overall, VAS's liability in damages to MSL of £16,600 net of VAT falls to be reduced by £2582.65.
59. The parties have agreed that MSL is, in addition, entitled to contractual interest in the amount of £2217.62 (taking account of a small amount of interest payable to VAS). The total liability of VAS to MSL for breach of the contract to refurbish the Abar is, therefore, £16,234.97. I give judgment accordingly.