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Work-life balance and equality for employees in geothermal power plants in an operational and social context

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ABSTRACT

Increasing focus on work-life balance in our society challenges a conventional view on shifts and working hours in the Icelandic power plant operations sector. The demand for greater gender equality is also driving change in the employers' perspective.

ON Power has been reassessing the company's approach towards these aspects. In 2018, ON Power changed working hours, shortening the working day from 9 to 8 hours and removed shifts on weekends and 24-hour at-plant presence. This change has created better opportunities for employees to gain work-life balance and equal participation of both genders in family life. The reason for the changes, risk assessment, the reception and effect on operations, as well as employees, is discussed in this paper.

In order to assess the effects of these changes a variety of factors are considered including; Availability of production, which has stayed high; Overtime hours for both employees and contractors, which have decreased; Job satisfaction, which has increased. Overall the changes have led to a better workplace at no apparent cost to operational reliability.

1. INTRODUCTION

Workers in trades are in high demand and attracting and retaining talent is an important task for any company which needs skilled workers. In a recent survey from The Federation of Icelandic Industries 76% of responding employers reported a shortage of tradespeople compared to 8,5% reporting a shortage of workers with a university degree (Samtök iðnaðarins, 2018). It is vital to Icelandic industries to increase the number of tradespeople. Women constitute 47% of the Icelandic workforce, they comprise only 16% of those graduating as certified tradespeople (Kvennastarf, 2019), there is an opportunity in enlarging the talent pool by attracting more women into the field.

For people working in industry, long working days have been the norm. To attract and retain talent, both male and female, companies have increasingly focused on improving working conditions and employees' work-life balance. This challenges a conventional view on working hours and shift work in the Icelandic power plant operations sector.

ON Power has been reassessing its approach towards these aspects, particularly for power plant operations, pioneering in promoting equality and social responsibility. In April 2018, ON Power implemented shorter working days, replacing a set-up where on-site staff worked long hours at the company's power plants, including over-weekend shifts requiring presence on-site. With shorter working-days, ON Power aimed to implement two kind of changes: First, to increase employee's opportunities for work-life balance and thereby attract and retain much needed talent. The second change was removing barriers to equal participation in family life in a very male dominated field. Contributing to a more balanced society, at a larger scale with equal participation from men and women.

This paper addresses some of the experiences of this modern approach to the operation of geothermal power plants in Iceland. The remainder of the paper is structured as follows. In the next section, we describe ON Power's geothermal power plants and the working hour set-up before the changes. Section 3 presents the working hour set-up after the change, both regarding shorter workdays and changes in shift work. Section 4 describes the reasoning behind the decision to change working hours as relating to diversity, efficiency and operational reliability. Section 5 presents our main results regarding impact on operation. In Section 6, we summarize and formulate conclusions.

2. POWER PLANT OPERATIONS BEFORE THE CHANGES

ON Power owns and operates 2 geothermal power plants in Iceland, Nesjavellir and Hellisheiði. Both plants are combined heat and power plants located around the Hengill central volcano in the southwest of Iceland, some 25 km east of Reykjavík. Nesjavellir is located northeast of Hengill and has an installed capacity of 120 electric megawatt (MW_e) and 300 thermal megawatt (MW_{th}). Hellisheiði is located southwest of Hengill and has an installed capacity of 303 MW_e and 133MW_{th}. Driving from Reykjavík to Nesjavellir takes about 45 minutes and driving from Reykjavík to Hellisheiði takes about 30 minutes.

The plants are operated by a team whose top priority is to keep the plants running. This team consists of 8 electricians and 8 mechanical engineers, 2 of which are on call at Hellisheiði and 2 at Nesjavellir. Which two are on call rotates through the year, each person being on call at Hellisheiði for 1 week, followed by a week off work, followed by 2 weeks working day shifts, see Figure 1. This cycle repeats for each of these employees twice at Hellisheiði then twice at Nesjavellir and keeps alternating. Being on call before the changes meant that you were at the plant or in the staff housing next to the plant 24/7, this was to reduce reaction time if unforeseen incidents occurred. During the on-call weeks these employees work a day shift from 7:30 to 17:30 from Monday to

Monday while on the day shift weeks they worked from 7:30 to 16:25 from Monday to Friday. Other onsite staff include office workers, specialists and managers, a total of about 30 staff. These workers worked from 7:30 to 16:25 Monday through Friday.

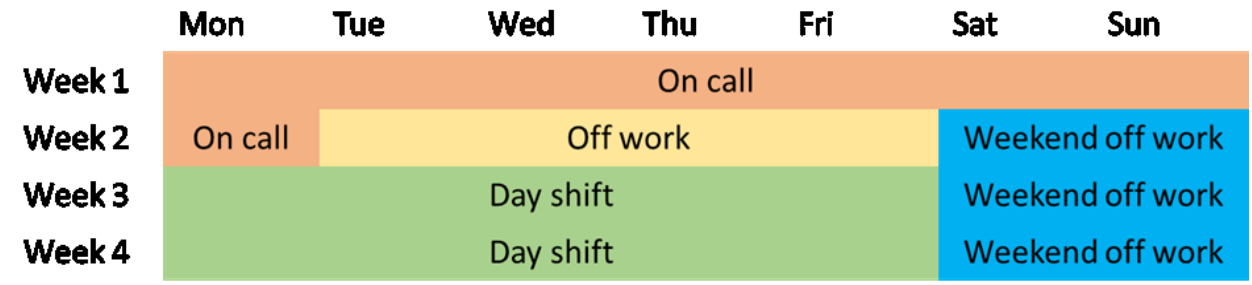

Figure 1: Example of the 4-week schedule of a power plant operator before the changes were made.

Along with this there was, and still is, a 24/7 control center in Reykjavík that monitors the power plants production and alarm lists and initiates the calls to the on-call operators when required. This watch is run by Reykjavík Energy, ON Powers' parent company.

3. THE CHANGE

3.1 Shortening the working hours for all staff

One of the hurdles for gender equality are long working hours that do not match the opening hours for children's day cares and schools. This puts our employees' households in a position where one of the providers needs to commit themselves to working less in order to be able to deliver and pick up the children within the opening hours, typically from 8 to 17. The usual arrangement is for women to take on the task of dropping off and picking up children and the men working longer hours. This, therefore, dis-proportionally affects women's career choices and thereby their quality of life. We decided to change our working hours from 9 to 8 hours a day and, to match the opening hours of institutions, chose to start our day at 8:20 and finish our day at 16:15. The gender equality benefit from this change is two-fold: first of all, new working hours enable both providers in the household to participate in dropping off and picking up children in daycare and school and thereby enabling father's to participate more in their children's lives, and secondly it enables mothers to select an occupation without facing long working hours in a male dominated industry.

3.2 Changing the shifts from being on-site to being on call from home

The geothermal power plants have over the past decade been continuously improved and developed by resolving initial faults in the startup phase and resolving operational issues when they had occurred by, to a large extent, implementing permanent solutions. This has resulted in steady operation and ability to control the power plant remotely as it was originally designed to do. This along with the power plants' location which is within a 30-minute drive from the capital area, and many other towns in the south-west region, has enable the modernization of the shift schedule for the power plant operators. Aiming for more flexibility for our operators we decided to implement an on-call setup where the operators would be on-call at home and hence removing the requirement of being on site 24/7 during their shift week when they are on call. Furthermore, we changed their daily workhours to match that of the other employees going from 8:20 to 16:15 on weekdays only and no work during weekends or holidays, only standing the shift being on-call from home. By this we eliminated the fixed workhours of 10 hours per day on-site regardless of weekends and holidays etc.

In order to not reduce the overall hours and the operator's paycheck they instead got 3 weeks daytime for the rest of their 4-week schedule; meaning that their week off is eliminated, see Figure 2. During the process of making this change, however, not all operators welcomed this part of change as days off were much appreciated by some.

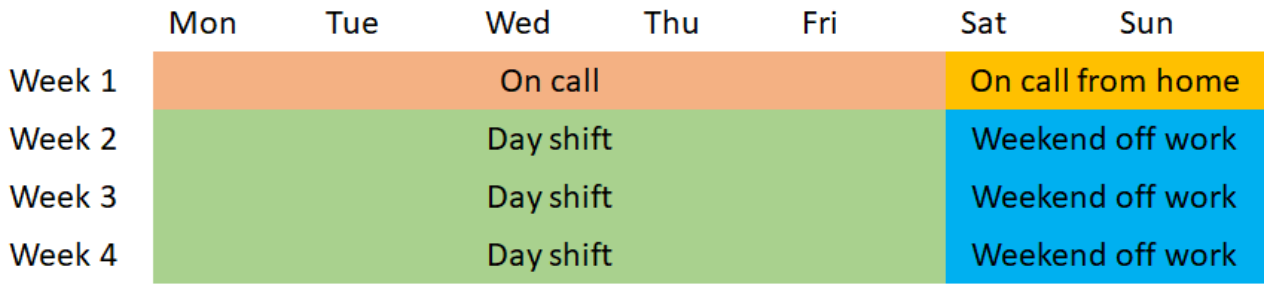

Figure 2: Example of the 4-week schedule of a power plant operator after the changes were made.

4. THE REASONING

4.1 A diverse workforce leads to better performance

The energy sector is a male dominated field, both in Iceland and the rest of the world (Konur í orkumálum, 2017). Women are 21% of ON Power's employees, with only 10% of power plant operation staff being women. Employers and researchers continue to improve their understanding of how workforce diversity influences organizations, work teams, and individual employees. Numerous studies seem to confirm that the potential benefits of workplace diversity do not accrue automatically (Jackson & Joshi, 2004).

Research shows that when diversity is managed effectively and the work environment supports and values a diverse workforce, benefits can include greater innovation, improved strategic decision-making, and organizational performance (Jackson, Joshi, & Erhardt, 2003; Webber & Donahue, 2001). Moreover, diversity enriches the workplace by broadening employee perspectives, strengthening their teams, and offering greater resources for problem resolution (Cox 2001). The creative conflict that may emerge leads to closer examination of assumptions, a more complex learning environment, and, arguably, better solutions to workplace problems (Gurin, Nagda, and Lopez 2004). Because of such competitive advantages, companies increasingly rely on a heterogeneous workforce to increase their profits and earnings (Florida and Gates 2001; Ryan, Hawdon, and Branick 2002; Williams and O'Reilly 1998).

Diversity also matters in the war for talent. Studies show that companies that manage diversity are more attractive to women and minority groups and initial evidence shows that high achievers rate organizations with diversity management as more attractive as potential employers (Ng, Burke, 2005). As follows, less diverse companies are less attractive to women, costing the companies access to the resources that female employees could have brought to the table (Kravitz, 2003). Considering the scarcity of women in the energy sector, closing the corporate gender gap isn't a side issue. It's an economic necessity. Programs and policies designed to reduce bias and ensure fairness don't just benefit women. They benefit everyone.

4.2 Long working hours reduce efficiency

Research has shown that long working hours (more than 40 hours per week) introduce a risk to both the worker and the employer. Studies show that long working hours are significantly related to adverse health outcomes such as cardiovascular diseases, diabetes, disability retirement, and poor physical health (Cygan-Rehm, Wunder, 2018). Long working hours have also been shown to be a significant source of stress (Spurgeon, Harrington, and Cooper, 1997) and relating to a higher probability of mental health problems (Cottini, Lucifora, 2013). Long hours are also a safety issue with research showing that employees at work for a long time may experience fatigue or stress that not only reduces his or her productivity but also increases the probability of errors, accidents, and sickness that impose costs on the employer (Pencavel, 2014; Spurgeon, Harrington, and Cooper, 1997).

In addition, research examining the relationship between workers' output and their working hours suggest a non-linear relationship: below a certain threshold, output is proportional to the hours worked; above a certain threshold, output per working hour decreases (Pencavel, 2014). This threshold is likely to vary across types of work and between workers, depending also on factors such as work organization (Collewet & Sauermann, 2017).

4.3 Insignificant risk of longer physical response time

For decades the perception in the Icelandic energy industry has been that the operator's presence onsite during their on-call shifts was necessary in order to ensure high availability of units and to respond to and de-escalate any unforeseen incidents. An analysis of calls for our on-call shifts showed that looking back a couple of years there had been 512 calls in total for both power plants and that approximately half of the calls were resolved through our SCADA system (our remote operating system that allows the operators to monitor the plants and make some adjustments when needed), and therefore did not require any inspection on site. Furthermore the severity of the call incidents was analyzed and it showed that approximately 82% of all calls had low severity and could wait until the next working day to be resolved, about 16% of the incidents had medium severity where an inspection on site would be beneficial, and only 2% of the incidents had high severity and required immediate action.

Out of the high severity incidents it was assessed that only one incident might have benefitted from the operator's presence onsite, and the consequences of a 30 minute longer reaction time would most likely have resulted in approximately 70.000 EUR in equipment damage. In all other cases presence on site would not have made a significant difference. In addition, it has been assessed that in major incidents the need for external assistance is quite likely as two operators will not be able to resolve major incidents on their own, and in that case the reaction time of any additional staff is at least 30 min (from the capital area). Hence the presence of two operators on-site can generate a sense of false sense of security. Running a power plant will never be completely risk free and based on the incident analysis the risk of introducing an on-call shift setup where the operator can be on-call from home is assessed to add insignificant risk to the operation.

5. THE IMPACT

Changes such as these can impact various parts of operation and performance. Some of the main areas, as well as some side effects, are discussed here.

5.1 Availability of production units stays high

One of the key performance indexes for most power plants is the availability of production. This is a measure of how much of a given period each production unit is available to produce power; this generally excludes planned stops. ON Power has had a high availability of production for a long time and one of the concerns of changing from on-site staff 24/7 to 8/5 was that this would go down. However, the risk of this was deemed acceptable due to the low number of incidents and the fact that response time to site would only be lengthened by about 30 minutes. Despite all this, availability of production has gone up since the changes were introduced, see Figure 3. This increase in availability, however, is not significant but it demonstrates that the changes have not had a detrimental effect on availability of production.

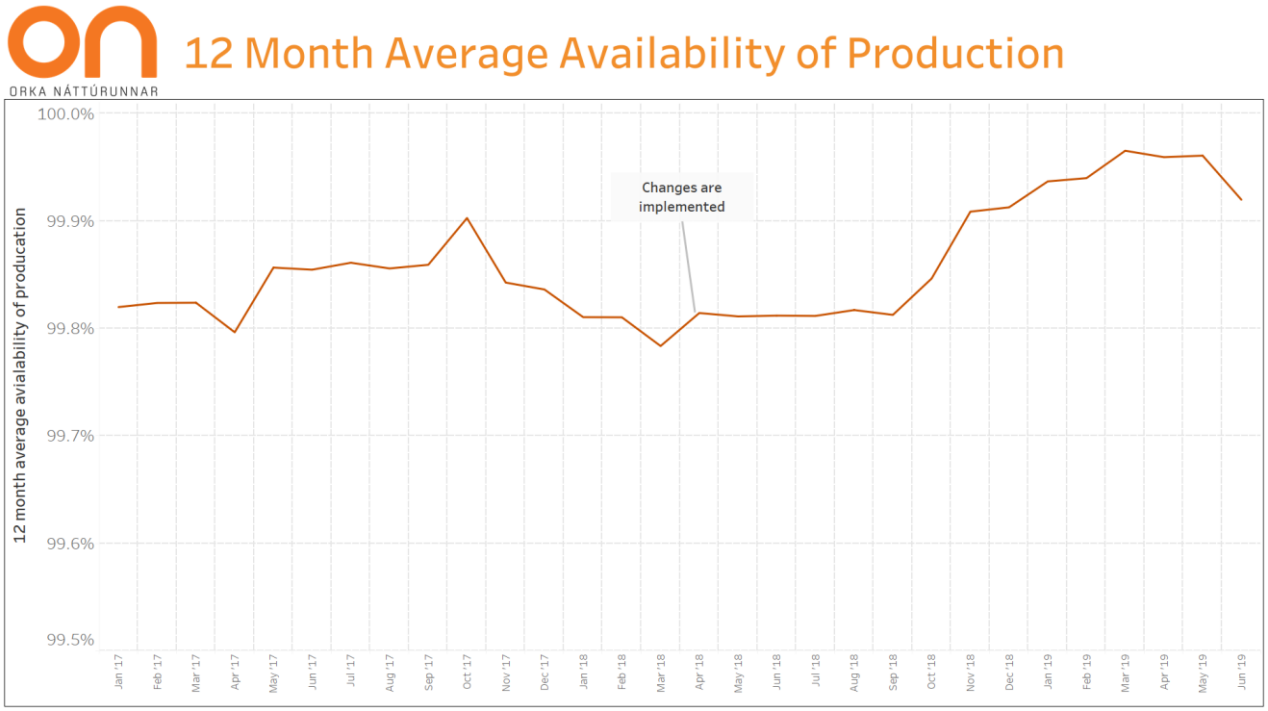

Figure 3: 12-month average of availability of production at Hellisheiði and Nesjavellir from January 2017 through June 2019.

5.2 Overtime hours have been reduced

Since the changes were implemented the number of overtime hours has reduced drastically for both Plant Operations employees and contractors. When looking at data from the start of 2017 to June of 2019 one can see that the average number of overtime hours has dropped by 43% for Plant Operations employees, see Figure 4, and 27% for contractors, see Figure 5.

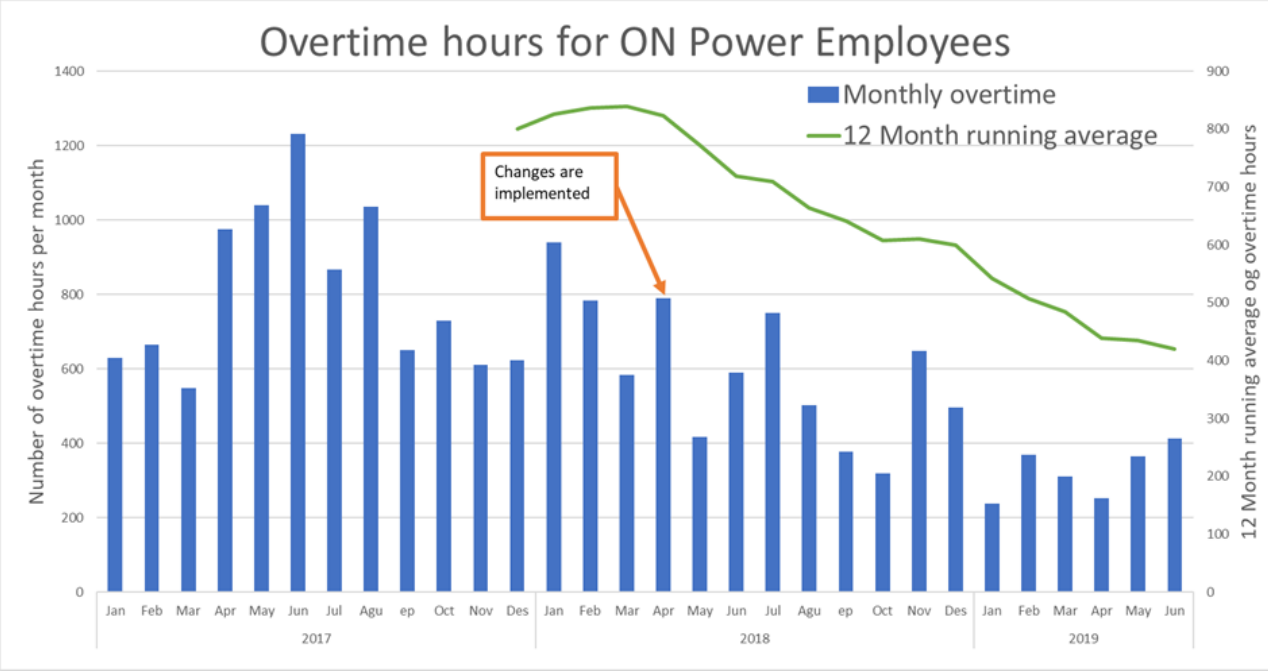

Figure 4: Overtime hours for ON Power Plant Operation employees. The 12-month average has been steadily going down since the changes were implemented and are now almost half of what they were before.

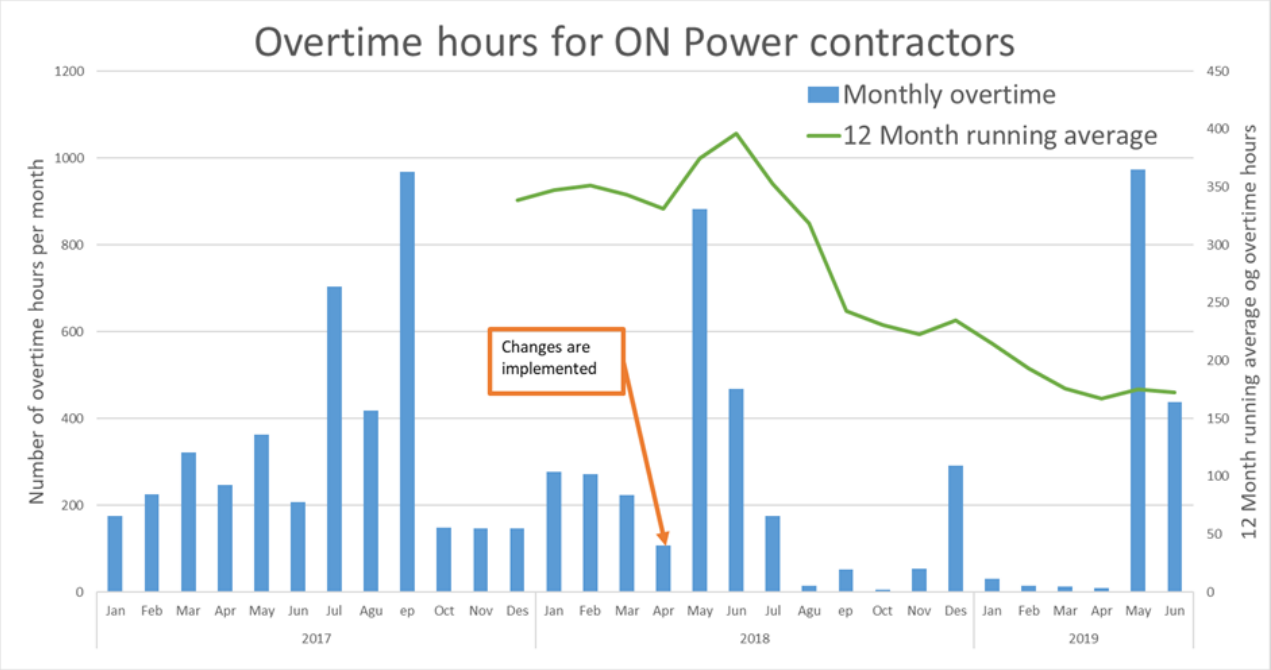

Figure 5: Overtime hours for contractors working for ON Powers' Plant Operation. The 12-month average has been steadily going down since the changes were implemented and are now about half of what they were before. The spikes in overtime are mostly due to critical maintenance like turbine overhauling. In such cases the loss of revenue justifies the overtime needed to get the units back online sooner.

5.3 Job satisfaction has increased

In the middle of, as well as at the end of, each year all employees at Reykjavík Energy, and its subsidiaries including ON Power, take a survey on job satisfaction. The results are given on a scale of 1 to 5, 1 being the worst possible score and 5 being the best possible score. The statements used to measure job satisfaction are "All things considered, I am happy in my job" and "I look forward to showing up to work". The change over time in answers to these statements, for ON Powers' power plant operation employees, can be seen on Figure 6. After the changes were announced in late 2017 job satisfaction dropped by 5.5% and 6 of the plant operators sought new employment due to the changes. However, after the changes took place and the new system had been in place for about 8 months job satisfaction had increased by 12.5%, to an all-time high of 4.35. The data indicates that work time change had a positive effect on job satisfaction, although other factors may have contributed as well.

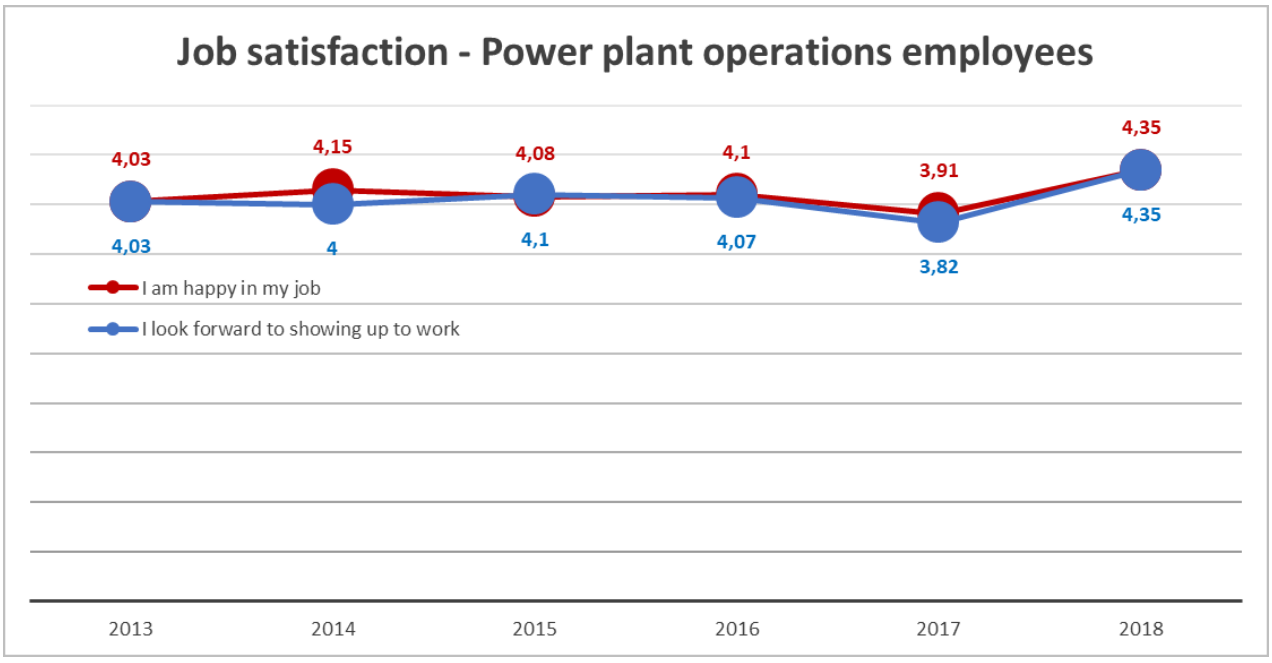

Figure 6: Job satisfaction of ON Powers' power plant employees. Two of the statements used to measure job satisfaction in an annual survey, "All things considered, I am happy in my job" and "I look forward to showing up to work". Results are given on a scale of 1 to 5; 5 being the best possible result and 1 being the worst possible result. Job satisfaction has never been higher.

5.4 Number of job applications received from women

One of the major goals of these changes was to encourage women to consider a career in plant operation as an option. While the number of applications from women skyrocketed after the changes (when looking at job postings from the start of 2017 the increase was tenfold when looking at the percentage of female applicants out of all applicants) these changes are hard to attribute to the worktime changes at this point. The jobs being posted are vastly different and looking at a very small pool of equivalent job postings shows no significant difference.

5.5 No rise in number of calls requiring on-call staff to go on site

The plant operators are now on call from home, as opposed to being near the power plant while on call. Instead of having to go to the plant every time they receive a call, a system to allow them to work remotely has been implemented. This system allows them to monitor the power plants and make some adjustments remotely. One of the concerns about shortening the workday was that the number of calls requiring operators to be physically present at the plant would increase. The number of these calls has stayed very similar since the changes were made, see Figure 7. The number of calls not requiring a physical response (those that can be solved remotely, don't need a response or can be handled later) however, has doubled.

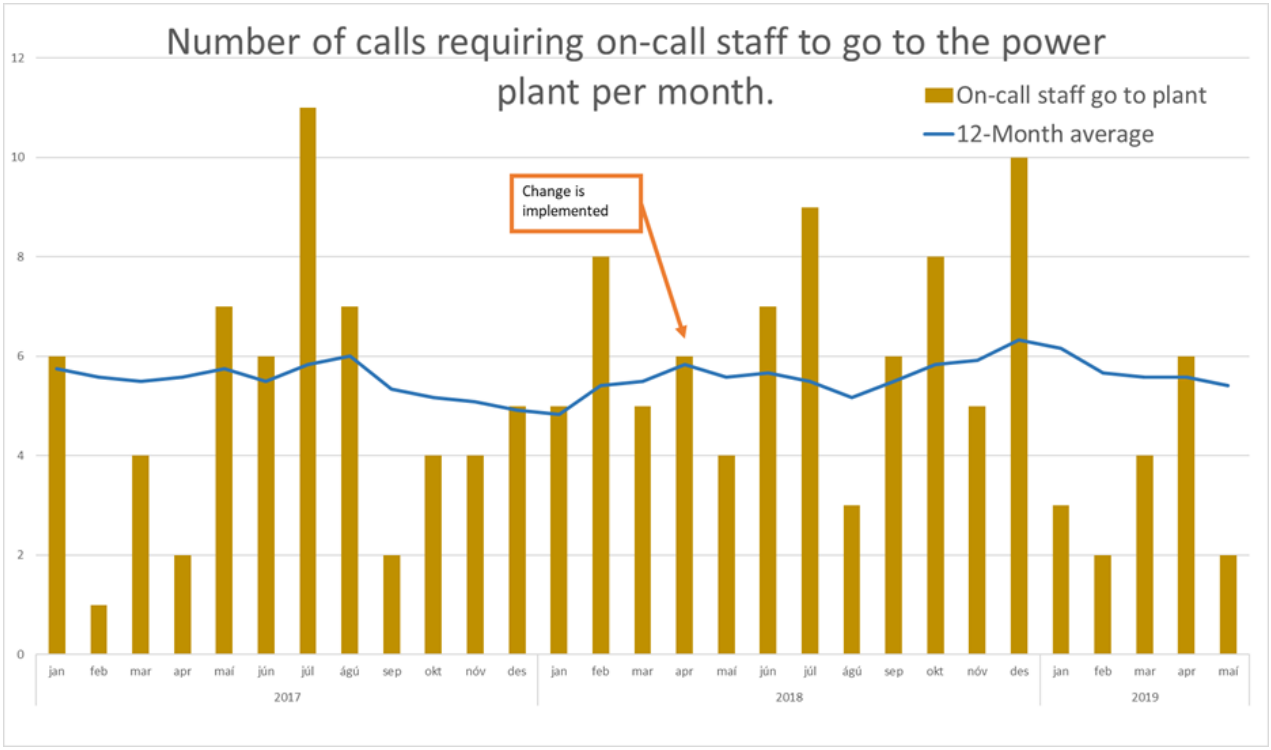

Figure 7: Number of calls to plant operators requiring a physical presence per month from the beginning of 2017 through May 2019. The bars represent each month while the blue line represents the 12-month average. No significant change has been in these types of calls.

5.6 Side effects

The changes have had some other side effects that are worth mentioning.

5.6.1 Contractors shorten their workday

When the workday at the plants was shortened this was applied to everyone working at the plant, both ON Powers' employees and contractors. The changes met some resistance from contractors, since this was coming to them as a demand from a separate company. This, however, was expected and ON Power worked steadily towards shortening the workdays for everyone at the plant. This was done by giving everyone a certain grace period in which to adapt to the changes and gradually reduce the leniency towards working outside of regular hours. Now, many of the contractors are on board and it is only in exceptional circumstances that anyone works at the plant outside regular hours.

5.6.2 Better flow of assignments

With the changes made to the work cycle of the plant operators (they no longer are off work for one week out of every four) assignments flow better. This is largely because people don't fall "out of the loop" while away on a regular basis anymore. Operators are at the plant all working days, even when not on call, and know what is going on. This means that they don't need to get an update and spend time getting back in sync when they get back to work after a week off.

6. SUMMARY AND CONCLUSION

Shortening the work hours and changing the operator's shifts to being on call from home is a modern approach to geothermal power plant operations. It is imperative for ON Power to attract and retain talent in a job market with a shortage of tradespeople. Designing

working conditions in a way that supports greater work-life balance is an important step towards that goal. In this paper the reasoning behind deciding to change working hours was discussed, i.e. how a diverse workforce leads to better performance, how long working hours reduce efficiency, and how incident analysis showed insignificant risk of a longer physical response time. Furthermore, the impact of the changes was discussed, showing that availability of production units is still high, that both staff and contractors are working fewer overtime hours and that job satisfaction among power plant operation staff has never been higher. More time is needed to assess the effect on job-applications received from women, although first numbers are promising. Contrary to concerns, shortening the workday has not resulted in a rise in calls requiring operator presence on site. In addition, a positive side effect has been better flow of assignments and workers being more in the loop, leading to more efficient work.

In summary, the changes in working hours and shift work were implemented to increase equal opportunity of all genders to achieve work-life balance and consequently increasing the attractiveness of ON Power as a workplace. For companies facing a shortage of workers, it is imperative to create a work environment in which workers experience job satisfaction and work-life balance. Overall, the changes discussed in this paper have led to a better workplace at no apparent cost to operational reliability. It is our belief that the changes will support ON Power in attracting and retaining talent, both among men and women. In addition, ON Power is showing social responsibility by increasing work-life balance in a male dominated field and removing barriers to equal participation in family life, contributing to a more balanced society with equal participation from men and women.

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