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Study on the cause of casing damage and the feasibility of comprehensive prevention

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Abstract: Through the study of casing damage in oil and water wells, the causes of casing damage are found out. At the same time, a set of systematic prevention and control methods are summarized based on the fine geological research results and the combination of dynamic and static conditions. The source of water inflow is cut off in time, effectively preventing the further spread of casing damage area, which plays an important role in controlling casing damage speed and improving the development effect of casing damage area.

keywords: Causes of casing damage   Study on prevention and control methods cognition.

1. Cause analysis of casing damage

In only two years, 15 oil and water wells have casing damage, with casing damage rate of 19.7%, including 11 of 24 water injection wells, with casing damage rate of 45.8%, which shows that the casing damage situation in this area is very serious.

The reservoir exploitation in the casing damage area is mainly based on the off surface reservoir, and a small part is the main thin layer sand on the surface and the non main layer sand on the surface. The oil layer is poorly developed, and the pressure loss of injected water during seepage is large.

From the perspective of casing damage, casing damage wells are concentrated, and the casing damage layer is mainly I-II interlayer, and the casing damage depth is near the perforation top boundary. Through analysis, it is believed that the main reasons for casing damage are as follows:

1.1 Casing damage is induced by injected water flowing into non oil layer along well section with poor cementing quality

The reservoir development is dominated by Group II. According to the statistics of isotope data of water injection wells in recent two years, Layer II1-4 has a high water absorption ratio and is the main water absorption layer of the whole well. If the cement bonding quality outside the pipe at the top boundary of the perforation is poor and there is a channeling channel, the injected water in layer II1-4 will directly enter the mudstone to form a flooding area to induce casing damage. According to the statistics of the secondary acoustic changes of the three casing damaged water injection wells, 28.7% of the wells are from the cement return height to the bottom boundary of the measurement, and 10.2% of the wells are from the top boundary of the perforation with worse cementing quality (see table). It can be seen that the hidden danger of cementing quality is the main factor leading to casing damage in this area.

Table 1. Statistics of Cementing Quality of Three Casing Damaged Water Injection Wells by Secondary Acoustic Variation Measurement

Number of wells	Segmentation	Total thickness（m）	Cementation			
			Medium cementation（m）	Poor cementation（m）	Medium to poor cementation	
					Subtotal（m）	proportion（%）
3 ports	I Top to perforation top boundary	41.8	21.1	6	27.1	64.8
	Perforation top boundary to II4 bottom	48.8	29.8	14	43.8	89.8
	Cement returns to the bottom of measurement	1064.8	386	372.7	758.7	71.3

1.2 Casing damage is related to lithology

From the lithological characteristics of 0-I and I-II interbeds, 0-I interbeds are gray black mudstones, with three layers of low-quality oil shale or ostracode mudstones in the middle, I-II interbeds are gray black ostracode mudstones at the top, gray black mudstones at the middle, and a layer of dark gray ostracode layer and a layer of marlstone at the bottom. The volume expansion of the interbed mudstones can reach about 7% after the montmorillonite content is relatively enriched and water is absorbed, Therefore, after absorbing water, the mudstone expanded with water will inevitably increase its plasticity, reduce its ability to withstand vertical rock pressure, and generate creep pressure on the casing, which will damage the casing.

1.3 Delayed or delayed scrapping of staggered water injection wells is also the cause of casing damage in this area

The water injection wells M and N are staggered at the I-II interlayer successively. It can be seen from the micro structural map that M well is at the structural high point and N well is at the structural low point. Through analysis, it is believed that the water injection well M at the structural high point was not found in time after the staggered fracture, and the later scrapping was not timely. The injected water continued to enter the formation along the staggered fracture, resulting in the staggered fracture of the adjacent water injection well N at the same layer.

2. Study on the feasible method of casing damage prevention

In view of the casing damage situation in this area, we have deeply studied the causes of casing damage in each well, applied fine geological research results, summarized and implemented comprehensive prevention and control measures in combination of static and dynamic, and achieved some results.

2.1 Use various monitoring means to find and cut off the source of water inflow in the shortest time to prevent further spread of casing damage.

A comprehensive prevention and control plan was developed for timely finding the causes of casing damage wells, including 22 wells for isotope production, 2 wells for noise leak detection, and 13 wells for casing damage re zoning in the casing damage area. After the implementation of the plan, 11 wells were found to be unable to be pulled out, and the wells were shut in immediately to reduce harmful water injection. Through careful analysis, the water inlet wells * and * * were found and cut off in time to prevent further spread of casing damage in this area.

2.2 Maintain block pressure balance and prevent casing damage at oil reservoir

In order to maintain the pressure balance in this area, 9 wells were overhauled and opened in a timely manner, and the repaired water injection wells have polished the II1-4 layers to prevent the injection water from channeling upward, coordinate the supply and drainage of oil and water wells, improve the injection production system, and reduce the hidden danger of casing damage. At the same time, the three water injection wells that failed to be overhauled were scrapped in time to prevent further expansion of casing damage.

2.3 Strengthen on-site inspection of water injection wells from the ground to eliminate hidden dangers of casing damage.

Regularly check the admission of on-site data of water injection wells, the implementation of the system by post workers, improve their awareness of casing damage protection, earnestly implement the casing protection laws and regulations, and timely solve the problems found in the inspection. Strictly adhere to the reporting system of abnormal wells, immediately test the D well with abnormal pressure and water volume, and find that the pipe string fails, and timely operate to find that the well cannot be pulled out.

2.4 Improve cementing quality and prevent new water source

The use of casing external packer above the perforation top boundary can more effectively block the water channeling due to poor cement bonding. There are 7 downhole cement surface control tools in the secondary wells in the casing damage area this year. In addition, in order to improve the anti extrusion ability of the casing itself, N80 high anti extrusion casing is run into all the oil and water wells that are injected later. In addition, it is planned to conduct secondary acoustic variable cementing quality logging for the water wells in this area, shut down the water injection wells with poor cementing at the top of perforation according to the logging results, and repair some water injection wells with poor cementing by using cement sheath repair technology, so as to reduce the reduction of the degree of reservoir production caused by the shutdown or shut in.

2.5 Investigate the immersion area, and stop the injection of the water injection well II1-4 layers in the casing damage area in time to prevent the injection water from channeling upwards

According to the statistics of the water injection intensity of 24 whole wells, the effective water injection intensity of 18 water injection wells in Layer II1-4 is relatively high. In order to prevent the injection water from channeling upward, the water immersion area is judged according to the transverse map of the new wells and the electrical logging curve. At the same time, the layer II1-4 of the water injection wells is exposed in time in combination with the isotope data, and the wells with abnormal noise curves are subdivided. In addition, 2 staggered oil wells around the staggered water injection well continue to produce and relieve pressure, so as to narrow the scope of the immersion zone. The pressure relief measures were taken for 4 oil wells by injecting the I-II interlayer.

3. Conclusion and understanding

Casing damage will damage the well pattern and affect the oilfield development effect. In order to fully understand the cause of casing damage and clarify the ideas and direction of casing damage control, this paper draws the following conclusions through the analysis and research on casing damage situation in this area:

3.1 Poor cementing quality and mudstone swelling are the main reasons for casing damage in this area;

3.2 The casing damage at non oil layer can be avoided to some extent by using the cement surface control tools and running the high anti extrusion casing. For the casing damage wells at the newly emerging I-II interlayer, the investigation of the well conditions of water injection wells should be strengthened to reduce the hidden dangers of casing damage;

3.3 For the damaged casing area, it is necessary to timely scrap the water injection well project that has not been wrongly broken during the overhaul, continue the production and pressure relief of the wrongly broken oil well, or select the adjacent oil well to re shoot the I-II interlayer for pressure relief, which can effectively control the further spread of the immersion area;

3.4 It is necessary to strengthen the dynamic monitoring work in the casing damage area, grasp the trend of casing damage at any time, and take preventive measures.

References

1. Lei Chen,Jianjun Xu,Shuang Chen,Hui Yang,Linhu Liu. Power Quality Disturbance Signal Denoising Based on Overcomplete Representation. IEEJ TRANSACTIONS ON ELECTRICAL AND ELECTRONIC ENGINEERING.2022; 17: 544–555
2. Xu Jianjun, Huang Lida, Yan Limei, Yi Na. Insulator Self-Explosion Defect Detection Based on Hierarchical Multi-Task Deep Learning. Transactions of China Electrotechnical Society, 2021,36(07):1407-1415.
3. Yan Limei,LIU Yongqiang,XU Jianjun,et al.Broken string diagnosis of composite insulator based on Grabcut segmentation and filler area discrimination.Power System Protection and Control,2021,49(22):114-119
4. Yi, Q. Wang, L. Yan, et al., A multi-stage game model for the false data injection attack from attacker's perspective. Sustainable Energy Grids & Networks 28 (2021).
5. Na Yi,Jianjun Xu,Limei Yan,Lin Huang. Task Optimization and Scheduling of Distributed Cyber-physical System Based on Improved Ant Colony Algorithm. Future Generation Computer Systems, 109(Aug. 2020),134-148.

6. Yang Zhao, Jianjun Xu, Jingchun Wu. A New Method for Bad Data Identification of Oilfield Power System Based on Enhanced Gravitational Search-Fuzzy C-Means Algorithm. IEEE Transactions on Industrial Informatics. VOL. 15, NO. 11, NOVEMBER 2019 5963-5970